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84-1568

IN THE

SUPREME COURT OF THE UNITED STATES

October Term, 1984

No.____

QUAKER CITY GEAR WORKS, INC., *et al.*,
Petitioners,

v.

SKIL CORPORATION,
Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

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QUESTIONS PRESENTED

1. On a motion for judgment n.o.v., to what extent, if any, should the evidence to be considered extend beyond the evidence in support of the verdict?

2. Is the rule of law against reweighing the evidence on a judgment n.o.v., as laid down in *Tennant v. Peoria & P.U.R. Co.*, 321 U.S. 29 (1944), applicable in all litigation in the federal courts including patent suits?

3. Does the law impose a more stringent standard for the granting of a judgment n.o.v. in favor of a moving party having the burden of proof as to the contested issue, than the standard otherwise applicable?

LIST OF PARTIES

Petitioners are Quaker City Gear Works, Inc. of Pennsylvania ("Quaker City") and Karlheinz Roth, a citizen of West Germany ("Roth"). The patent in suit was acquired from Roth by Quaker City and hence the actual party in interest is the latter.

Respondent is Skil Corporation of Chicago, Illinois ("Skil").

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OPINIONS BELOW

The 22 interrogatories to the jury and the responses appear in Appendix A herein, page A-1.

The Memorandum and Order of the United States District Court for the Eastern District of Pennsylvania, dated September 21, 1983, granting respondent's Motion for Judgment N.O.V., is unreported and appears in Appendix A herein, page A-8.

The Order of the United States District Court for the Eastern District of Pennsylvania dated October 25, 1983, denying the timely motion to amend the judgment rendered September 21, 1983, is unreported and appears in Appendix A herein, page A-15.

The Opinion of the United States Court of Appeals for the Federal Circuit dated November 9, 1984, affirming the District Court's holding of patent invalidity is reported at 747 F.2d 1446, and appears in Appendix A herein, page A-17.

The Order of the United States Court of Appeals for the Federal Circuit dated January 3, 1985, denying a timely filed Petition for Rehearing and Suggestion for Rehearing In Banc, is unreported and appears in Appendix A herein, page A-46.

JURISDICTION

The Judgment of the United States Court of Appeals for the Federal Circuit as to which certiorari is sought was entered on November 9, 1984 (App. A, p. A-17).

The Petition for Rehearing and Suggestion for Rehearing In Banc was timely filed on December 7, 1984, and was denied by an Order dated January 3, 1985 (App. A, p. A-46).

The instant petition is being filed within ninety days of January 3, 1985, the date of the denial of the Petition for Rehearing. The jurisdiction of this court is invoked under 28 U.S.C. §1254(1).

CONSTITUTIONAL AND STATUTORY PROVISIONS AND RULES INVOLVED

Article I, Section 8, Clause 8 and Amendment VII of the United States Constitution, Title 35, U.S. Code §112 and 282, and Rules 49(a) and 50(b) of the Federal Rules of Civil Procedure are involved. These are set forth in Appendix A, pp. A-85-A-89.

STATEMENT OF THE CASE

Quaker City Gear Works, Inc. ("Quaker City") sued Skil Corporation ("Skil"), alleging that Skil willfully infringed Quaker City's gear patent No. 3,247,736 issued April 26, 1966, to Karlheinz Roth, assignor to Quaker City. Dr. Roth, a citizen of West Germany employed there as a College Professor, was joined as an additional plaintiff after Skil's motion to compel his joinder was granted.

The subject matter of the patent is a pinion-and-gear combination in which the pinion has four or fewer teeth, making possible a great speed reduction in a single stage of gearing, while retaining the gear strength required for power transmission. The suit resulted after Skil adopted a single stage speed reduction system in accordance with claims 1 and 2 of the '736 patent for many of its electric drills, relying upon a four-tooth pinion and the high gear ratio made possible. This obviated two (tandem) speed reduction gear stages, simplifying the electric drill, and made it more economical.

A separate jury trial was held on the issue of liability. It concluded in the submission to the jury of a series of 22 interrogatories. The overall effect of the jury's answers was summarized by the District Court thus:

> ". . . when one reviews the jury's answers to the twenty-two interrogatories as a whole, they are sufficiently consistent to indicate the jury's intent to return a verdict for the plaintiffs. . . ." (App. A, p. A-11)

Among these interrogatories propounded to the jury were several interrogatories listing various prior patents and publications, and asking the jury whether the patented invention would have been obvious in view thereof — interrogatories which the jury answered in the negative. (App. A, pp. A-3 and A-4). Also included were Interrogatories 20, 21 and 22 concerning infringement and willfulness, in response to which the jury gave affirmative answers, that the Skil drills (typified by Model 560) use gearing which infringes the Roth patent, and that the infringement by Skil Corporation is willful (App. A, p. A-7).

Interrogatory No. 11, which relates to and takes wording from the first paragraph of 35 U.S. Code §112 (App. A, p. A-4) is copied below:

Interrogatory #11

> Does the specification of the Roth patent, that is, the portion of the patent in Columns 1, 2, 3, 4 and the first four lines of Column 5, contain a written description, including its drawings and text, of the alleged invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same?

The jury's answer to this Interrogatory No. 11 was: YES. (App. A, p. A-4).

Following the special verdict expressed through the jury's answers to interrogatories, defendant brought a motion for judgment n.o.v., or for a new trial, *inter alia*. Among the many grounds urged was defendant Skil's contention that the Court should award judgment to it on the ground that the '736 patent is invalid under the first paragraph of 35 U.S. Code §112. Skil contended that the reason the specification of the '736 patent does not suffice to enable persons skilled in the art to make and use the invention is because of dependency upon a

foreign publication mentioned in certain places in the patent, namely, a German Industrial Standards publication referred to as "DIN 58400."

On September 21, 1983, the District Court issued its Memorandum and Judgment Order in favor of defendant (App. A, pp. A-8 to A-14). It rejected several of defendant's contentions, but ruled in favor of defendant on its contention that the German Industrial standard 58400 was "essential material" to supplement or augment the disclosure of the '736 patent to enable persons skilled in the art to make and use the invention, wherefore the District Court, by judgment n.o.v., held that the specification of said United States patent does not ". . . contain a written description . . . of the alleged invention in such full, clear, concise and exact terms as to enable any person skilled in the art . . . to make and use the same," notwithstanding the jury's affirmative answer to Interrogatory No. 11. (App. A, pp. A-9 and A-10). It therefore held the patent invalid and granted judgment n.o.v.

The District Court's erroneous view was:

> "No interrogatory was requested or submitted to the jury concerning whether the German Standard was essential material. Accordingly, under Fed. R. Civ. P. 49(a) the court may make this finding of fact. . . ." (App. A, pp. A-9 & A-10, emphasis added)

Petitioners appealed. The Court of Appeals for the Federal Circuit held that a finding of fact that the German document was not essential was "an implicit and inherent finding of the jury within a broader question," and hence, "the court had to accept the jury's determination and could set it aside only if it were not supported by substantial evidence." (App. A, pp. A-28 & A-29). Accordingly, it held that the District Court was incorrect as a matter of law in deeming itself free to make an initial fact finding as to essentiality.

However, the Court of Appeals for the Federal Circuit neither reversed nor remanded the case. Instead, it reweighed the evidence on both sides of the question of essentiality, without benefit of observing the witnesses, and relying on inferences of its choice and on its interpretation of excerpts of attorney correspondence, to reach its own finding of fact opposite to the jury's, that the U.S. patent had a fatal deficiency of disclosure without the German publication, making that document essential. That resulted in an affirmance of the District Court's *result*, i.e. judgment of dismissal. (App. A, pp. A-29 to A-33).

This patent infringement litigation presents questions as to the law's restrictions on the power of an appellate court to reweigh conflicting evidence and grant judgment notwithstanding the verdict on a matter which a jury resolved in reaching its special verdict. It raises the need for the Supreme Court to express itself as to the limitations upon a court's power to substitute its weighing of the evidence for that of a jury on a disputed factual issue. Urgency of this need for judicial guidance results from the pronounced tendency of the recently established Court of Appeals for the Federal Circuit to develop, and then to be guided mainly by, its own body of precedential law. (Infra, p. 6, n. 1).

REASONS FOR GRANTING THE WRIT

The Need For Resolution Of The Question As To The Evidence To Be Considered On A Motion for Judgment N.O.V.

In laying the groundwork to reweigh the evidence, the Court of Appeals for the Federal Circuit rejected the view that it is to "look only to evidence in [plaintiff Quaker City's] favor to determine whether 'substantial evidence' supports the implicit factual finding that the German Standard was not 'essential material'," stating

"[t]he law is clearly to the contrary." (App. A, p. A-31). It cited a prior decision of the same court for the proposition that "a court must *consider all the evidence* (emphasis the Court's) (App. A, p. A-31).[1] The Court of Appeals cited testimony of Berlinger and Drago which stands in support of this factual finding by the jury, without finding any fault. (App. A, pp. A-29 & A-30). It then launched into an extended evaluation of several portions of the evidence adduced by defendant Skil, including, *inter alia*, Roth's testimony about his German application and the German standards paper. The Court deemed these, considered together, sufficient to convince it that Skil should prevail on the ground of unavailability of a German standards publication of a certain "draft," that document being adjudged by it, as opposed to the jury's finding, to be "essential material" to Roth's U.S. patent. The Court did not explain how it could reach this conclusion without taking into account the very extensive differences between the earlier German application and the U.S. patent (with its far more complete description).[2] In any event, this reweighing of the evidence was not in accordance with the law.

In *Wilkerson v. McCarthy*, 336 U.S. 53, 57, 69 S. Ct. 413, 415 (1949), the Supreme Court said:

> "It is the established rule that in passing upon whether there is sufficient evidence to submit an is-

1. Most of the precedents cited are earlier decisions of the same Court, handed down since late 1982 (App. A pp. A-17 to A-35). In its first appeal to be heard, *South Corp. v. United States*, 690 F.2d 1368 (Fed. Cir. 1982), said Court sat in banc expressly "to consider what case law, if any, may appropriately serve as established precedent." Its resolution of this question was: "We hold that the holdings of our predecessor courts, the United States Court of Claims and the United States Court of Customs and Patent Appeals, announced before the close of business September 30, 1982, shall be binding as precedent in this court."

2. The substantial additional material in the patent is shown in the side-by-side comparison of the German application and the U.S. patent in App. B, pp. B-9-B-18.

> sue to the jury we need look only to the evidence and reasonable inferences which tend to support the case of a litigant against whom a peremptory instruction has been given."

The *Wilkerson* case was an FELA case. Some writers have questioned whether the Supreme Court intended this rule to apply broadly to all litigation, or intended it to be applicable only to FELA and Jones Act cases. Among the comments on this rule are those offered by Wright and Miller, Federal Practice and Procedure, Vol. 9, §2529, pp. 572-573. Said authors advocate a rule "that the Court may consider all of the evidence favorable to the position of the party opposing the motion as well as any unfavorable evidence that the jury is *required* to believe." (id., at 573). The authors add, "*[b]ut statements that all of the evidence is to be considered are too broad.*" (id., emphasis added).

It would be a significant service to the bench and bar for the Supreme Court to express itself on this point, not only to promote uniformity of action on motions for directed verdicts and for judgments n.o.v. among all the Courts of Appeals, but also, to provide reassurance that in cases involving patents, the same principles and rules of law governing jury trials apply which are recognized and relied on in the other segments of the law.

In a dissent to denial of *certiorari* in *Schwimmer v. Sony Corp. of America*, 103 S. Ct. 362 (1982), the view was expressed that it would be beneficial to resolve the differences among the circuits "concerning the portion of the evidence a court is to consider in ruling upon a motion for judgment notwithstanding the verdict." (103 S. Ct. at 363). As the dissenting Justice observed, "[b]ecause the scope of review will often be influential, if not dispositive, of a motion for judgment n.o.v., this disagreement among the federal courts of appeals is of far more than academic interest." (103 S. Ct. at 364).

In the present case, the Court of Appeals for the Federal Circuit deemed the scope of review to be crucial, and looked back only as far as an earlier case of the same court, and an inapposite case decided by this Court in 1951.[3] Had there been a prior resolution of the conflicts as to scope of review, it could well have been dispositive here with an opposite result.

The Reweighing of the Evidence by The Court of Appeals For The Federal Circuit Was In Contravention of Established Law

When defendant Skil moved for a directed verdict of invalidity on the ground that a German publication (a DIN 58400 Industrial Standards publication) was "essential material" necessary to be considered along with the United States patent in suit in order for it to provide an enabling disclosure, the District Court, after extensive discussion of that motion, denied it (Appendix A, pp. A-73 to A-76), ruling that the matter must proceed to the jury. This action by the District Court was proper, because there was conflicting testimony and there were conflicting inferences to be drawn and conclusions to be reached.

After receiving the jury's special verdict, holding in favor of the plaintiff, the District Court once again had the question whether a DIN 58400 German paper was "essential material" raised by defendant Skil's motion for judgment n.o.v.

Erroneously believing itself free to do so under Fed. R. Civ. P. 49(a), the District Court proceeded to weigh the evidence and pass judgment that a DIN 58400 paper was essential — that without it, the U.S. patent fails to

3. *Universal Camera Corp. v. National Labor Relations Board*, 340 U.S. 474, 71 S. Ct. 456 (1951), was cited for comparison to the holding that *all* the evidence is to be considered. That case did not involve a jury verdict. Instead, it involved review by Courts of Appeals of orders of the National Labor Relations Board, in compliance with the Wagner Act.

provide such disclosure of the invention as to enable anyone skilled in the pertinent art to make and use the invention. A preponderance of the evidence as viewed by the District Court would suffice according to its erroneous theory, said Court's appraisals of credibility and assignments of weight being taken into account.

When the Court of Appeals for the Federal Circuit ruled that Fed. R. Civ. P. 49(a) does not apply here since the jury had made the inherent finding that the German paper is not essential, this should have resulted in a reversal of the District Court's judgment n.o.v., since the evidence before the jury involved evidence on both sides of the question of sufficiency of the disclosure of the United States patent to enable those skilled in the art to make and use the invention. This fact was acknowledged to the jury by defendant Skil. Skil reminded the jury of the testimony of Bobel and Thoen, urging the jury to find believable their testimony critical of the patent, but acknowledged that their testimony was opposed to the testimony of Drago and Berlinger, leaving the jury to determine which it found more persuasive (App. A, A-79 to A-81). Skil also included its contention that Professor Roth had made an admission about a German publication being necessary, and urged the jury to conclude that in the absence of such publication, the patent could not provide the required *enabling* disclosure. As Skil acknowledged to the jury concerning Interrogatory 11, "*you've got conflicting tesimony.*" (App. A, p. A-80).[4]

Since it is indisputable that the jury was confronted with and had to resolve conflicting testimony, weighing all the evidence as to enabling disclosure in reaching its finding as set forth in answer to Interrogatory No. 11 and

4. The District Court also charged the jury to much the same effect in regard to Interrogatory 11, thus: "You've heard a lot of evidence in this case, and once again I will not repeat it or make reference to who called the various witnesses, but there has been a lot — a lot of evidence as to this particular issue and it's for your determination." (App. A, p. A-81).

its overall special verdict in favor of plaintiff, and since the specific question of "essential material" *had indeed* been considered by the jury and resolved in favor of petitioners, the Court of Appeals for the Federal Circuit was not free to reweigh the evidence and redecide the question of essentiality of the German paper for an enabling disclosure of the *United States patent*, overturning the jury's finding. *Continental Ore Co. v. Union Carbide and Carbon Corp.*, 370 U.S. 690, 696-97 and 700-701, 82 S. Ct. 1404, 1409 and 1411 (1962), *Tennant v. Peoria & P.U.R. Co.*, 321 U.S. 29, 35, 64 S. Ct. 409, 412 (1944). See U.S. Constitution Amendment VII (App. A, p. A-89).

In the *Tennant* case, in reversing a judgment *n.o.v.* below, the Supreme Court stated the law as follows:

> It is the jury, not the court, which is the fact-finding body. It weighs the contradictory evidence and inferences, judges the credibility of witnesses, receives expert instructions, and draws the ultimate conclusion as to the facts. The very essence of its function is to select from among conflicting inferences and conclusions that which it considers most reasonable. That conclusion, whether it relates to negligence, causation, or any other factual matter, cannot be ignored. *Courts are not free to reweigh the evidence and set aside the jury verdict* merely because the jury could have drawn different inferences or conclusions *or because judges feel that other results are more reasonable.*
> [citations omitted]
>
> (321 U.S. at 35, emphasis added).

In the *Continental Ore* case, the Supreme Court, citing *Tennant*, observed,

> Undoubtedly, all of the evidence during this period does not point in one direction and different inferences might reasonably be drawn from it. There was, however, sufficient evidence to go to the jury

and it is the jury which "weighs the contradictory evidence and inferences" and draws "the ultimate conclusion as to the facts."

The fact that the Court of Appeals for the Federal Circuit indulged in reweighing the evidence is borne out by the several items of evidence it selected and relied on as tending to support the non-enabling disclosure result it reached (opposite to that of the jury). (App. A, pp. A-32 to A-33). Its failure to reach the same result as the jury's may well have resulted from the Court of Appeals seemingly having totally disregarded the great differences between Professor Roth's quite self-sufficient U.S. patent and his German application — the only one as to which he was asked about referring to DIN 58400.

In Weighing the Evidence, the Court of Appeals for the Federal Circuit Casts Aside The Rule of Law That The Direction of the Burden of Proof is Significant

The opinion of the Court of Appeals for the Federal Circuit demonstrates obliviousness to the principle of law that an especially high standard is to apply where the burden of proof as to the matter in issue is on the party moving for a directed verdict or for judgment *n.o.v.*

That rule is quite generally applied by the textbooks, the U.S. Courts of Appeals and District Courts, and various state courts.[5] Among the U.S. Court of Appeals cases on this rule of law are:

Allen v. Zurich Ins. Co., 667 F.2d 1162, 1164-65 (4th Cir. 1982)

Mihalchak v. American Dredging Co., 266 F.2d 875, 877 (3rd Cir.), *cert. denied* 361 U.S. 901 (1959)

Fireman's Fund Ins. Co. v. Videfreeze Corp., 540

5. See for example 88 CJS Trials §257, pp. 667-71. See also Wright & Miller, Federal Practice and Procedure, Vol. 9, §2535, pp. 592-93.

F.2d 1171, 1177 (3rd Cir. 1976), *cert. denied* 429 U.S. 1053 (1977)
Service Auto Supply Co. of P.R. v. Harte & Co., 533 F.2d 23, 25 (1st Cir. 1976)
Powers v. Continental Casualty Co., 301 F.2d 386, 388 (8th Cir. 1962)
Hurd v. American Hoist & Derrick Co., 734 F.2d 495, 498-99 (10th Cir. 1984)

So far as petitioner can determine, the Supreme Court has not expressed disapproval or approval of the principle for which these cases stand.

Allen v. Zurich Ins. Co. has much in common with the present case. After plaintiff Allen obtained a jury verdict, the defendant successfully moved for judgment n.o.v. Upon Allen's appeal, the Court of Appeals overturned the District Court's granting of judgment n.o.v. to Zurich Insurance Co. on an affirmative defense, stating:

> Applying that [stringent] standard to the evidence in this case, we do not think it was appropriate to grant judgment n.o.v. for Zurich on this basis. The dispositive issue was whether at the critical time Allen was Scruggs' employee acting in the course and scope of his employment. . . ."
>
> (667 F.2d at 1165)

The court in that cited case recognized that "the evidence was in substantial conflict," and that the method of payment and right to fire could "lead to conflicting inferences." (id.). As the court observed,

> We must bear in mind the critical point that here the burden of persuasion was not upon Allen to establish that he was not Scruggs' employee, but upon Zurich to establish that he was. To hold that Zurich was entitled to judgment as a matter of law we must find that not only was there sufficient evidence, so manifestly credible that it must be believed, to sup-

> port a finding that Allen was Scruggs' employee, but also that there was insufficient evidence from which the jury could rationally have made any other finding. [citation omitted] This we cannot do, and we therefore conclude that the district court erred in granting judgment n.o.v. on this basis.
>
> (667 F.2d at 1165)[6]

In the present case, the defendant Skil had the burden of persuasion that the Roth U.S. patent was fatally deficient in its disclosure, [i.e., that it did not suffice to enable persons skilled in the art to make and use the invention]. This parallels the cited case wherein the defendant Zurich had the burden of persuasion that the plaintiff Allen was an employee of Scruggs. Thus, unless and until this Court should announce a turning away from all the foregoing authorities, the Court of Appeals for the Federal Circuit should be led to come into conformity with the several other circuits, the text writers, and the cases in numerous state courts, to recognize that judgment n.o.v. should not be freely granted to the party having the burden of persuasion as to the issue to which its motion for judgment n.o.v. is directed.

Under 35 U.S. Code §282 (App. A, p. A-86), "A patent shall be presumed valid. . . . The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity." Among the invalidity defenses to be alleged and proven by an accused infringer-defendant under this section is "(3) Invalidity of the patent or any claim in suit for failure to comply with any requirement of sections 112 or 251 of this title." (App. A, p. A-86.)

Since defendant Skil alleged invalidity of the Roth U.S. patent for failure to meet the enabling disclosure

6. The Court of Appeals for the Fourth Circuit ultimately held for the defendant-appellee Zurich on different grounds, i.e., on judicial estoppel, in view of certain inconsistencies in Allen's main representations.

requirement of Section 112 of Title 35 (App. A, p. A-85). Section 282 placed upon Skil the burden of establishing invalidity on that ground. Therefore, the rule of law of the above-cited cases and texts applies.

The Court of Appeals for the Federal Circuit, whether or not with full awareness of the impact, has substituted its own opposite finding of fact for that of the jury, in disregard of, or in derogation of, the law on the significance of the burden of proof.

Unless the law of *Allen v. Zurich Ins. Co.* and the numerous other above-cited cases is to be overturned, the Court of Appeals for the Federal Circuit should have been required to conform. It should have faced up to the requirement (paraphrasing the *Allen* case) that it "find that not only was there sufficient evidence, so manifestly credible that it must be believed, to support a finding that [a German paper was essential for enabling disclosure in the U.S. patent in suit], but also that there was insufficient evidence from which the jury could rationally have made any other finding." Here, as in the cited case, the Court could not have metthat requirement. Upon respecting the established law, it would have had to reverse the judgment n.o.v.

A pronouncement on this rule of law by the Supreme Court should put this matter to rest and provide valued guidance for the bench and bar.

CONCLUSION

For all of the above reasons, we respectfully suggest that certiorari be granted, that the judgment of the Court of Appeals be reversed, and that the case be remanded for the further proceedings consistent with the jury's verdict.

Respectfully submitted,

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October Term, 1984

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v.

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APPENDIX A TO PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

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Amendment VII — Constitution of the United States A-89

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

QUAKER CITY GEAR WORKS, INC. ROTH, KARLHEINZ	:	CIVIL ACTION
vs.	:	
SKIL CORPORATION	:	NO. 79-2287

Interrogatory #1

Do you find that the scope and content of the prior art applicable to the subject matter of the patent includes the following references:

Reference/ Description	Defendant's Exhibits	Yes	No
1956 AGMA Standard Publication 207.04	134		✓
1961 Thoen Paper	43		✓
1961 Thoen Paper	44		✓
1959 Buckingham Manual	51		✓
1942 Japanese Patent 147,790	41		✓
1951 Japanese Publication "A Study on Involute Helical Gears"	57		✓
1960 Roano Patent	36		✓
1948 Vogel Publication	45		✓
1953 Japanese Book "Gear Wheel"	56		✓

Interrogatory #2

Did a person of ordinary skill in the subject of gearing as of December 1963 have:
(Check more than one if applicable.)

1. A bachelor's degree in engineering and at least several years experience in the design of pinions with a small number of teeth, say in the order of 10 or less teeth.

YES ____ NO ____ Could not agree

2. At least some formal education of a technical nature after high school and at least several years experience in the design of pinions with a small number of teeth, say in order of 10 or less teeth.

YES ____ NO ____ Could not agree

Interrogatory #3

Do you find that the prior art being relied upon by Skil, as represented by the following references:

(a) The 1956 AGMA Standard 207.04 (DX-134) and

(b) the Thoen publications regarding four-tooth pinions (DX-43 and DX-44),

is more pertinent than the five patents (DX-32, DX-33, DX-34, DX-37 and DX-39) cited by the United States Patent Office during examination of the Roth application?

YES ____ NO ✓

Interrogatory #4

Do you find that the prior art being relied upon by Skil, as represented by the following references:

(a) Buckingham's Manual of Gear Design (DX-51),

(b) the Japanese patent (DX-41) and Japanese publications (DX-56 and 57),

(c) the Roano patent (DX-36),

(d) the Vogel publication (DX-45),

is more pertinent than the five patents (DX-32, DX-33, DX-34, DX-37 and DX-39) cited by the United States

Patent Office during examination of the Roth application?

YES ___ NO ✓

Interrogatory #5

If you answered Interrogatory No. 3 "Yes" and thus found the 1956 AGMA Standard 207.4 (DX-134) and the 1961 Thoen publications (DX-43 and DX-44) to constitute more pertinent prior art, do you find that plaintiff Roth knew of this prior art and intentionally failed to call it to the attention of the U.S. Patent Office?

YES ___ NO ✓

Interrogatory #6

Do you find that it would have been obvious in December of 1963 for a person having ordinary skill in the art of small gear design, who had before him the 1956 AGMA Standard 207.04 (DX-134) to design a 4-tooth helical pinion which would satisfactorily mesh with a complimentary gear of helical form?

YES ___ NO ✓

Interrogatory #7

Do you find that it would have been obvious in December of 1963 for a person having ordinary skill in the art of small gear design to modify the Thoen 4-tooth spur pinion (DX-43 and DX-44) to include a helix angle?

YES ___ NO ✓

Interrogatory #8

Do you find that it would have been obvious in December of 1963 for a person having ordinary skill in the art of small gear design, who had before him the Japanese Patent (DX-41) and Japanese publications (DX-56 and DX-57) to design a 4-tooth helical pinion which

would satisfactorily mesh with a complimentary gear of helical form?

YES ___ NO ✓

Interrogatory #9

Do you find that it would have been obvious in December of 1963 for a person having ordinary skill in the art of small gear design, who had before him the Roano patent (DX-36) to design a 4-tooth helical pinion which would satisfactorily mesh with a complimentary gear of helical form?

YES ___ NO ✓

Interrogatory #10

Do you find that it would have been obvious in December of 1963 for a person having ordinary skill in the art of small gear design, who had before him all of the prior art, if any, checked "yes" by you in interrogatory #1 to design a 4-tooth helical pinion which would satisfactorily mesh with a complimentary gear of helical form?

YES ___ NO ___

Not applicable

Interrogatory #11

Does the specification of the Roth patent, that is, the portion of the patent in Columns 1, 2, 3, 4 and the first four lines of Column 5, contain a written description, including its drawings and text, of the alleged invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same?

YES ✓ NO ___

Interrogatory #12

Does the specification of the Roth patent, that is, the portion of the patent in Columns 1, 2, 3, 4 and the first four lines of Column 5, contain a written description, including its drawing and text, of the manner and process for making and using the alleged invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same?

YES ___ NO ___

Could not agree.

Interrogatory #13

As to each of Claims 1, 2 and 3 of the Roth patent, what is your finding as to whether or not it particularly points out and distinctly claims the subject matter which Roth regarded as his invention in December 1963?

As to Claim 1	YES ✓	NO ___
As to Claim 2	YES ✓	NO ___
As to Claim 3	YES ✓	NO ___

Interrogatory #14

Do you find that Claim 1 of the Roth Patent covers only combinations of helical gears which are inoperable or unworkable?

YES ___ NO ✓

Interrogatory #15

Do you find that the claims of the Roth Patent represent nothing more than an attempt to patent a mathematical expression?

YES ___ NO ✓

Interrogatory #16

Do the claims of the Roth patent represent nothing more than an attempt to patent a desired result, or a numerical limit or standard?

YES ____ NO ✓

Interrogatory #17

Do the claims of the Roth patent cover an arbitrary selection of a range in a known progressive change and thereby attempt to establish exclusive rights with respect to products falling within that range on the ground that the designated range produces optimum results?

YES ✓ NO ____

Interrogatory #18

Do you find that the inequality expression or formula in paragraph (a) of Claim 1 of the Roth patent (see column 5, line 12) is incorrect?

YES ____ NO ✓

Interrogatory #19

If you answered Interrogatory No. 18 "Yes," do you find that plaintiff Roth has attempted to enforce the patent against Skil well knowing that the Roth patent is defective because of the incorrect inequality expression or formula?

YES ____ NO ____

Not applicable.

Interrogatory #20

Did you find that the Skil pinion accused of infringement satisfies the helix angle requirements which are set forth in Paragraph (a) of Claim 1 of the Roth patent and which read:

"both gears are helical and helix angle is given by

$$-0.35z_v + 1.4 < \frac{b \sin B_o}{mn} < 1.5$$

wherein B = helix angle at the pitch cylinder, m_n = module, b = minimum tooth width and z_v = virtual number of teeth;"

YES ✓ NO ___

Interrogatory #21

Do the Skil drills typified by Model 560 use gearing which infringes at least one claim of the Roth patent?

YES ✓ NO ___

Interrogatory #22

If the answer to Interrogatory No. 21 is in the affirmative, is the infringement of the Roth patent by the defendant Skil Corporation willful?

YES ✓ NO ___

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

QUAKER CITY GEAR WORKS, INC. and KARLHEINZ ROTH, *plaintiffs*	:	CIVIL ACTION
vs.	:	
SKIL CORPORATION, *defendant*	:	No. 79-2287

MEMORANDUM

GREEN, *J.* September 21st, 1983

This case involves the alleged infringement of United States Letters Patent No. 3,247,736 entitled "Involute Gear Combinations" which issued April 26, 1966. The court has jurisdiction under 28 U.S.C. §1338(a). The case was tried to a jury on the issue of liability. The jury returned a special verdict by answering interrogatories in accordance with Fed. R. Civ. P. 49(a), after which the parties were given the opportunity to file any relevant motions. Plaintiffs moved for judgment and for the jury to consider the issue of damages. Defendant filed a motion styled as a motion for Judgment Notwithstanding the Verdict as provided in Fed. R. Civ. P. 50(b). Defendant's motion will be granted because plaintiff failed to comply with the specification requirements of 35 U.S.C. §112, thereby rendering its patent invalid.

Plaintiff, Quaker City Gear Works, Inc. ("Quaker") is the holder of the exclusive license under United States Patent No. 3,247,736 ("the Patent") by virtue of a license dated June 18, 1971. It has rights to grant sub-licenses, bring actions for infringement of the patent and collect damages for infringement. Plaintiff Karlheinz Roth is the patentee and owner of the Patent and is the grantor of the license to Quaker. Defendant Skil Corporation

("Skil") is a manufacturer of tools and other equipment. Skil manufactured electric hand held drills, Model Numbers 457, 560, 569, 584, 925, 928, and 931. The gear combination used in those drills was alleged to infringe the Patent.

The Patent related to a comination of involute gears in which the virtual number of teeth on the pinion (the smaller of the two meshing gears) was no more than five. Plaintiffs claim that the Patent was an advance in the art in that both the pinion and the wheel (the other gear) had good load-carrying capabilities, could be manufactured economically, and had good contact ratios.

Skil's argument that the Patent is invalid is based, in part, on the fact that the Patent specification makes six references to German Industrial Standard 58400 Draft September, 1963 ("German Standard") without specifying the standard or attaching a copy. Skil asserts that this incorporation by reference is insufficient to meet the standards of 35 U.S.C. §112.

Section 112 provides:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make or use the same, and shall set forth the best mode contemplated by the inventor of carrying out the same.

The parties dispute the degree of specificity required by the statute. Plaintiff argues that the reference to the German Standard is not problematical because it is only a suggested standard, not a mandatory one and therefore not "essential material," requiring disclosure under section 112.

No interrogatory was requested or submitted to the jury concerning whether the German Standard was essential material. Accordingly, under Fed. R. Civ. P. 49(a)

the court may make this finding of fact. The Manual of Patent Examining Procedures §601.01(p)(B) defines "essential material" as "that which is necessary . . . for adequate disclosure of the invention." In light of all the evidence, particularly Prof. Roth's testimony that the German Standard was "necessary" to design the wheel used in a related German patent, I find that the German Standard was "essential material" for the design of the Patent at issue here as well.

In *General Electric Co. v. Brenner*, 407 F.2d 1258, 1262 (D.C. Cir. 1968) the court held that incorporation by reference was permissible in patent law so long as the references were made to information which is available to the public. The court explicitly stated that the rule of incorporation by reference excluded "obscure foreign publications and publications for which there were no available English translations." *Id.* at 1262-63. In addition, the Manual of Patent Examining Procedures §601.01(p)(B) states that essential material may not be incorporated by reference to nonpatent publications, patents or applications published by foreign countries or regional patent offices or to United States patents or applications which incorporate essential material by reference.

It is clear from these guidelines that the reference to the German Standard was insufficient for compliance with the disclosure requirements of section 112. The document is a non-patent publication. It is not available in the United States Patent Office like a United States patent or patent application would be. Furthermore, it is so far removed from public availability that plaintiffs could not locate and produce a copy when so requested by the defendant.

Because of this error of attempting to incorporated the foreign document by reference, the patent does not comply with section 112 and is, therefore, invalid. Accordingly, Skil is entitled to Judgment Notwithstanding the Verdict.

Skil also argues that the jury's answers to the interrogatories should be disregarded because of inconsistencies among them. It is true that the jury's answers do not appear entirely consistent. Most notably, the jury's failure to find that any of the references listed in Interrogatory #1 were prior art seems inconsistent with the evidence of both parties. However, "[w]here there is a view of the case that makes the jury's answers to special interrogatories consistent, they must be resolved that way." *Atlantic and Gulf Stevedores, Inc. v. Ellerman Lines, Ltd.*, 369 U.S. 355, 364 (1962). Since the jury may have found that defendant did not meet its burden of proof on this issue, there is a construction which would render the answer consistent with the remaining interrogatories. Thus, Skil is not entitled to relief on the basis of the inconsistency in the answers.

Skil also points to the jury's failure to agree on an answer to Interrogatory #12 in support of its argument that the jury's findings were so inconsistent that they were not the product of rational decisionmaking.[1] However, when one reviews the jury's answers to the twenty-two interrogatories as a whole, they are sufficiently consistent to indicate the jury's intent to return a verdict for the plaintiffs. In any event, the failure to answer Interrogatory #12 would not entitle Skil to a judgment, but merely to a new trial on the narrow issue raised by that interrogatory. *Franki Foundation Co. v. Alger-Rau & Asso., Inc.*, 513 F.2d 581, 585 (3d Cir. 1975).

Defendant also argues that the trial by jury in this matter violated due process because the technical nature of the evidence was beyond the jury's ability to understand, thereby precluding the jury from rendering a rational decision. In support of its argument, Skil points to the inconsistencies in the jury's answers to interrogato-

---

1. The due process issue raised by this argument will be more fully discussed below.

ries, already discussed. Skil's argument raises the issue of the tension between the fifth amendment right to due process and the seventh amendment right to a jury trial.

This question was confronted in *In re Japanese Electronic Products Antitrust Litigation*, 631 F.2d 1069, 1079 (3d Cir. 1980) in which the court found that some cases may be too complex to be tried to a jury. The court stated that a suit might be "excessively complex as a result of any set of circumstances which singly or in combination render a jury unable to decide in [a] . . . rational manner." *Id.* The court adopted a balancing test, *id.* at 1084, but stated that it was adopting a "high standard" that would allow denials of jury trials "only in exceptional cases." *Id.* at 1088. The case before this court is not such a case.

The third circuit developed a standard with three factors for the district courts to consider in determining when a jury trial would violate due process. The district courts are to make an objective evaluation by examining:

> first, the overall size of the suit, the primary indicia of which are the estimated length of trial, the amount of evidence to be introduced and the number of issues that will require individual consideration; second, the conceptual difficulties in the legal issues and the factual predicates to these issues, which are likely to be reflected in the amount of expert testimony to be submitted and the probable length and detail of jury instructions; and third, the difficulty of segregating distinct aspects of the case, as indicated by the number of separately disputed issues related to single transactions or items of proof.

Id. at 1088-89.

Applying the standard to the case at hand, I find that this case is not one in which due process mandates that it not be tried to a jury. The overall size of the suit was not exceptionally great. The trial lasted less than two weeks, a time span that would not be unduly burden-

some for a jury. Although the testimony was frequently technical, it was not any more technical than a typical patent case and surely the standard was not to be applied to preclude jury trial in all patent cases. Furthermore, the case involved only two plaintiffs and one defendant, thus minimizing the conceptual difficulties in understanding the factual and legal issues involved. Consequently, even though twenty-two interrogatories were propounded to the jury, they did not have to segregate distinct aspects of the evidence for application to some parties, but not to others.

Although there is arguably some indication from the inconsistencies in the answers to interrogatories that this particular jury may have been confused, I do not find that trial by jury would necessarily deprive defendant of due process. Therefore, should a new trial be necessary, plaintiff would still be entitled to a jury trial.

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

QUAKER CITY GEAR WORKS, INC. and KARLHEINZ ROTH, *plaintiffs*	:	CIVIL ACTION
vs.	:	
SKIL CORPORATION, *defendant*	:	No. 79-2287

ORDER

AND NOW, this 21st day of September, 1983, for the reasons set forth in the accompanying memorandum, IT IS ORDERED that judgment will be entered in favor of defendant Skil Corporation and against plaintiffs Quaker City Gear Works, Inc. and Karlheinz Roth.

BY THE COURT:

_____

CLIFFORD SCOTT GREEN, *J.*

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

QUAKER CITY GEAR WORKS, INC. ROTH, KARLHEINZ	:	CIVIL ACTION
vs.	:	
SKIL CORPORATION	:	No. 79-2287

ORDER

AND NOW, this 25th day of October, 1983, upon consideration of plaintiff's motion to amend the judgment rendered September 21, 1983, defendant's response thereto and plaintiff's reply memorandum, it appears that plaintiff has not raised any issues which were not considered by the court and discussed in the memorandum of September 21, 1983. Accordingly, IT IS ORDERED that plaintiff's motion is DENIED.

BY THE COURT:

CLIFFORD SCOTT GREEN, *J.*

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

QUAKER CITY GEAR WORKS, INC. and KARLHEINZ ROTH, *Plaintiffs*	:	Civil Action No. 79-2287
v.	:	Judge Green
SKIL CORPORATION, *Defendant*	:	

NOTICE OF APPEAL

QUAKER CITY GEAR WORKS, INC. and KARLHEINZ ROTH, plaintiffs in the above-entitled case, hereby appeal to the United States Court of Appeals for the Federal Circuit from the judgment entered herein and the denial of the Motion to Amend Judgment dated October 26, 1983.

QUAKER CITY GEAR
WORKS, INC.
and KARLHEINZ ROTH

By_____
John W. Logan, Jr.
FERRILL AND LOGAN
550 Pinetown Road,
Suite 430
Fort Washington, PA 19034
(215) 643-5750

Dated: November 14, 1983

Court of Appeals, Federal Circuit

Quaker City Gear Works, Inc. et al.
v. Skil Corporation

Nos. 84-634 and 84-649

Decided Nov. 9, 1984

Before Bennett and Nies, Circuit Judges, and Cowen, Senior Circuit Judge.

Nies, Circuit Judge.

Appeal 84-634 is from the judgment of the United States District Court for the Eastern District of Pennsylvania (Green, J.), entered September 21, 1983, holding invalid U.S. Patent No. 3,247,736, owned by Quaker City Gear Works, Inc. The case was tried to a jury, which returned a special verdict under Rule 49(a), Fed. R. Civ. P., responding to a series of factual and legal questions tending to uphold Quaker City's position that its patent was valid and infringed. The district court, however, directed entry of judgment for Skil Corporation on the basis that the '736 patent failed to comply with the disclosure requirements of §112 by incorporating by reference "essential material" from an unavailable publication, German Industrial Standard 58400 (draft September 1963). We conclude that this action was correct.

In Appeal No. 84-649, Skil asks for attorney fees under 35 U.S.C. §285. We are unconvinced that the record provides a basis for finding the case to be "exceptional", as required for an award of attorney fees.

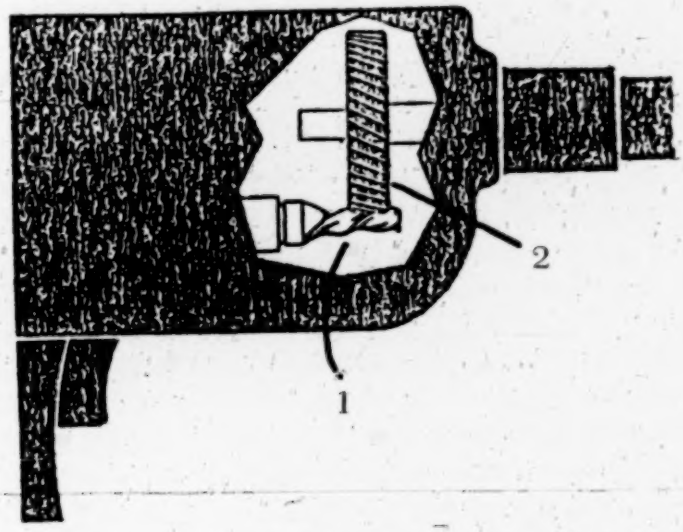
Accordingly, the judgment is affirmed.

Background

1. The Patent

The patent in suit, entitled "Involute Gear Combinations" and issued April 26, 1966 to Karlheinz Roth, relates to a speed-reduction gear train for the transmis-

sion of power in which a pinion with a relatively small number of teeth meshes and drives a parallel gear with a relatively large number of teeth.[1] The invention can be applied in the gearing mechanism for a hand-held power drill, as illustrated below:



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1. Exemplary claim 1 reads as follows:

1. A combination of involute gears in which the shafts of the two gears are parallel to one another and wherein the virtual number of teeth on the pinion is no more than five, comprising the following features:

(a) Both gears are helical and the helix angle is given by

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_o < 1.5$$

wherein B_o = helix angle at the pitch cylinder, m_n = module, b = minimum tooth width and z_v = virtual number of teeth;

(b) the pinion has a small addendum and a large useful dedendum (difference between useful height of tooth and addendum) if it is the driver, or a large addendum and a small useful dedendum if it is the driven, the profiles of the combination being complementary in respect of the tooth sides involved in power transmission;

(c) there is a profile deviation which is positive for the pinion in a step-down combination but negative in a step-up combination, and positive for the wheel in a step-up combination.

The pinion, or drive gear, labelled 1 in the above figure, has helical teeth which mesh with, and transmit power to, a second helical gear with many more teeth (the "wheel"), labelled 2. The gear curvatures are designed so that the number of teeth on the pinion is kept to a minimum, resulting in gear ratios obtainable in a single gear stage that were previously attainable only in multiple gear stages. The invention is advantageous in substantially lowering the cost of the gear train required for a given speed-reduction ratio.

The patent specification discloses both a single tooth and a double tooth pinion as embodiments of the invention. The specification teaches that, to practice the invention, the disclosed pinion is "preferrably combined" with a helical wheel gear made according to "German Industrial Standard 58400 draft September 1963." The standard, in fact, is mentioned at six locations in the specification as follows:

> Further, in a step-down involute gear combination according to the invention it is preferred to use as the basic profile for the wheel the standard profile for precision work as laid down by German Industrial Standard No. 58400 (draft September 1963).
>
> * * *
>
> The mating profile can be a standard profile, preferably according to German Industrial Standard 58400 draft September 1963 for the precision industry.* * *
>
> The standard profile for the precision industry according to German Industrial Standard No. 58400 is complementary to the basic profile of FIG. 1. * * * Thus, in the case of the standard profile according to German Industrial Standard 58400 draft September 1963, a portion of the dedendum available for power

transmission is not used in the gear combination in question.

* * *

The pinion of FIG. 4 can likewise be combined with a helical gear made according to German Industrial Standard 58400 draft September 1963. The basic profile of FIG. 2 is also complementary to the profile of German Standard 58400 draft September 1963. [Emphasis added.]

The standard is also claimed in dependent claim 5, a claim not in issue in the present litigation.

2. *The Patent Prosecution*

The Roth application was filed in the U.S. Patent and Trademark Office (PTO) on December 12, 1963. Although the patent issued with a claim for priority based on a German application, filed January 17, 1963, there are significant differences between the two applications, and Quaker City no longer relies on the earlier date.

The U.S. application received a first action allowance by the PTO examiner, with no questions raised as to the six references in the specification to the 58400 German Standard, despite the fact that the Standard was claimed in claim 5.

The Office Action allowing the application was sent to Roth's German patent agent by the U.S. patent attorney handling the prosecution. In a letter dated June 22, 1965, acknowledging receipt of the Office Action, the German patent agent wrote the U.S. attorney, querying:

In the English documents of the application, reference is made on several pages and also in claim 5 to the DIN Standard (German Industrial Standard) 58400 and also (on page 6, 1) to DIN 867. We ask you to check whether this reference to German

standards can be retained or whether it is necessary to carry out a substitution by American standards or by a literal description before the granting.

The U.S. attorney responded:

In connection with the reference to the German Industrial Standards appearing in the specification and Claim 5, *assuming that these Standards are available to the public in printed form*, we see no reason why it would be necessary to replace them in the specification by a reference to a corresponding United States Industrial Standard or by a more complete structural description. With respect to the use of this terminology in Claim 5, the situation is not quite so clear, but in our opinion, we believe that claim should be allowed to remain in its original form. We must point out that the use of this type of terminology in a claim is quite irregular by U.S. claim writing standards, and we are somewhat surprised that the Examiner did not object thereto. However, it is also true that some U.S. Examiners will allow considerable latitude in claiming an invention providing that the way in which the invention is claimed is not clearly contrary to established procedures. We believe that the Examiner could find no concrete reason for objecting to Claim 5 and, thus, he is prepared to allow it in its present form. *While we would have preferred to write a more exact description of the structure involved*, in view of the fact that the claim has been allowed and the Examiner has closed out prosecution on merits and, further, in view of the fact that Claim 5 is a dependent claim, we would suggest that this claim be allowed to remain as it presently is. We would suggest, however, that in any future cases where a similar situation is present that a more complete structural definition of the invention be given, particularly in the claims. We think that the present application in-

volves a unique situation in which the Examiner has gone much farther than is customary in allowing us to claim the invention in this fashion, and we think that it would be highly-doubtful that this would be repeated in another case. [Emphasis added.]

The U.S. application was thus issued without a description of the German Standard or a reference to any corresponding U.S. Standard.

3. District Court Proceedings

Quaker City instituted a patent infringement suit against Skil in the United States District Court for the Eastern District of Pennsylvania. Despite repeated discovery requests by Skil, Quaker City was unable to produce a copy of the referenced September 1963 draft of German Industrial Standard 58400.

The case was tried to a seven member jury over a two week period. The jury heard conflicting testimony concerning, inter alia, the adequacy of the patent disclosure to enable one of ordinary skill in the art to make and use the invention under 35 U.S.C. §112, first paragraph.[2] At one point, while being questioned on the related German priority application, the inventor, Roth, testified that the referenced German Standard was "necessary" to design the wheel of the invention.

At the conclusion of the trial, the jury was asked to return a special verdict in the form of answers to 22 interrogatories. In accordance with Judge Green's instructions, the jury did not answer questions on which they

2. 35 U.S.C. § 112 provides, in pertinent part:

The specification shall contain a written description of the invention, and of the manner shall contain a written description of the invention, and of the man and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

could not unanimously agree. The jury found that the scope and content of the prior art did not include any of nine references put into evidence by defendant, that the references were not more pertinent than art considered by the examiner, that the invention would not have been obvious from various combinations of the above references, that the patentee did not withhold pertinent prior art, that the claims distinctly claimed the invention, did not cover inoperable combinations of gears, did not attempt to patent a mathematical expression or merely a desired result, did cover an arbitrary range, and did not contain an incorrect formula. Finally, the jury found that Skil willfully infringed. The jury could not agree on whether the person of ordinary skill in the art had a high school or college education.

With respect to enablement, the specific interrogatories, and the answers provided by the jury, read as follows:

Interrogatory #11

> Does the specification of the Roth patent, that is, the portion of the patent in Columns 1, 2, 3, 4 and the first four lines of Column 5, contain a written description, including its drawings and text, *of the alleged invention* in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is more nearly connected, to make and use the same?
>
> Yes X ____

Interrogatory #12

> Does the specification of the Roth patent, that is, the portion of the patent in Columns 1, 2, 3, 4 and the first four lines of Column 5, contain a written description, including its drawing and text, *of the manner and process for making and using the alleged invention* in such full, clear, concise and exact

terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same?

Yes X ___

As indicated directly above, the jury could not agree on an answer to Interrogatory No. 12.

The jury's answers were recorded and the jury was released, subject to later recall, after which the parties were given the opportunity to file relevant motions. Quaker City moved for entry of an order in its favor on liability and for a trial with respect to damages. Skil moved for judgment in its favor under Rule 50(b), Fed. R. Civ. P.,[3] or for a new trial.

The district court granted Skil's motion solely on the basis that the patent was invalid for failing to comply with the disclosure requirements of 35 U.S.C. §112. The court based its decision on its finding that the German Standard constituted "essential material," noting, "No interrogatory was requested or submitted to the jury con-

3. Rule 50(b) provides:

(b) *Motion for Judgment Notwithstanding the Verdict.* Whenever a motion for a directed verdict made at the close of all the evidence is denied or for any reason is not granted, the court is deemed to have submitted the action to the jury subject to a later determination of the legal questions raised by the motion. Not later than 10 days after entry of judgment, a party who has moved for a directed verdict may move to have the verdict and any judgment entered thereon set aside and to have judgment entered in accordance with his motion for a directed verdict; or if a verdict was not returned such party, within 10 days after the jury has been discharged, may move for judgment in accordance with his motion for a directed verdict. A motion for a new trial may be joined with this motion, or a new trial may be prayed for in the alternative. If a verdict was returned the court may allow the judgment to stand or may reopen the judgment and either order a new trial or direct the entry of judgment as if the requested verdict had been directed. If no verdict was returned the court may direct the entry of judgment as if the requested verdict had been directed or may order a new trial.

cerning whether the German Standard was essential material," and that, therefore, under Rule 49(a), Fed. R. Civ. P.,[4] the court was free to make that finding. In making its determination the court stated:

> In light of all the evidence, particularly Prof. Roth's testimony that the German Standard was "necessary" to design the wheel used in a related German patent, I find that the German Standard was "essential material" for the design of the Patent at issue here as well.

The court then held that, under the guidelines set forth in General Electric Co. v. Brenner, 407 F.2d 1258, 1262, 159 USPQ 335, 338 (D.C. Cir. 1968) and the Manual of Patent Examining Procedure, §608.01(p)(B), reference to an unavailable non-patent foreign publication was clearly insufficient for compliance with §112.

The court ruled in the alternative that Skil was not entitled to relief on the ground that the jury's answers were inconsistent, although the court did note that "the

4. Rule 49(a) provides:

(a) *Special Verdicts.* The court may require a jury to return only a special verdict in the form of a special written finding upon each issue of fact. In that event the court may submit to the jury written questions susceptible of categorical or other brief answer or may submit written forms of the several special findings which might properly be made under the pleadings and evidence; or it may use such other method of submitting the issues and requiring the written findings thereon as it deems most appropriate. The court shall give to the jury such explanation and instruction concerning the matter thus submitted as may be necessary to enable the jury to make its findings upon each issue. If in so doing the court omits any issue of fact raised by the pleadings or by the evidence, each party waives his right to a trial by jury of the issue so omitted unless before the jury retires he demands its submission to the jury. *As to an issue omitted without such demand the court may make a finding;* or, if it fails to do so, it shall be deemed to have made a finding in accord with the judgment on the special verdict. [Emphasis added.]

jury's answers do not appear entirely consistent" and that "[m]ost notably, the jury's failure to find that any of the references listed in Interrogatory #1 were prior art seems inconsistent with the evidence of both parties." The court was also not concerned over the jury's failure to agree on an answer to Interrogatory #12, since in the court's view, "when one reviews the jury's answers to the twenty-two interrogatories as a whole, they are sufficiently consistent to indicate the jury's intent to return a verdict for the plaintiff." Finally, with respect to Skil's complaint that the technical nature of the evidence was beyond the jury's ability to understand, and that, therefore, under In re Japanese Electronic Products Antitrust Lit., 631 F.2d 1069 (3rd Cir. 1980), the case should not have been tried before a jury, Judge Green ruled that the subject matter was no more technical than a typical patent case, and that Skil has not been deprived of due process.

Quaker City subsequently filed a motion asking that the judgment be vacated, which was denied by Judge Green on the basis that the motion raised no issues that had not previously been considered.

With respect to Skil's request for attorney fees, which it made in its pleadings and its post-trial proposed conclusions of law, no specific ruling was made on the matter. The judgment simply contains no award.

Opinion

I.

When a special verdict is sought from a jury, the appropriate procedure is for the court to accept the findings of fact explicitly made or implicit in the jury's answers and based thereon and on such additional findings as the court may find necessary to make (Rule 49(a)), direct entry of judgment under Rule 58, Fed. R.Civ.P. In this case, there was some uncertainty concerning how to deal with the jury's special verdict even though it was

largely in Quaker City's favor, because all of the questions were not answered and because some of the answers, particularly the answer to Interrogatory 1 rejecting all proffered references from consideration as prior art, indicated a lack of comprehension of the issues. Because of its uncertain status as a "verdict",[5] Skil filed a motion for judgment under Rule 50(b) purportedly on the theory that "no verdict was returned." See Rule 50(b), supra note 3, last sentence. The court, however, termed and treated this motion as a 50(b) motion for judgment notwithstanding the verdict.

As an initial matter, with respect to terminology, Rule 49(a) speaks of "a special verdict in the form of a special written finding upon each of fact." Thus, the compilation of findings is "a special verdict." The rule contemplates that only factual questions will be submitted to the jury to which the judge will then apply the law, supplementing, in necessary, any factual determinations not submitted to the jury. 5A Moore's Federal Practice, §49.02, at 49-8 (2d ed. 1984). Where a special verdict does not contain one or more answers requested, it may, unless wholly defective, be accepted for those issues that are resolved. It is "a special verdict" to the extent findings are made (assuming the findings are not contradictory). Wright and Miller, Federal Practice and Procedure: Civil, §2510, at 520 (1971). A party may request reconsideration by the jury of unresolved factual issues in such case, or may be entitled to a retrial of those issues.[6] However, the right to trial by jury of any factual

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5. Adding to the uncertainty, the court specifically said there was no verdict, but merely answers to interrogatories. Undoubtedly, the court meant there was no general verdict for a party.

6. See Brown, Federal Special Verdicts: The Doubt Eliminator, 44 F.R.D. 338, 347-48 (1967) in which when C.J. Brown (5th Circuit) points out how a trial judge or an appellate court may save the "good" part of a first trial. See also Sunderland Verdicts, General and Special, 29 Yale L.J. 253 (1920); 5A Moore's Federal Practice, §49.02, at 49-6 (2d ed. 1984).

issue may be waived, for example, by that the jury need not answer all questions, and the court is empowered to complete the findings, apply the law, and direct entry of judgment. Thus, in this case, when the court determined that the answers given were reconcilable, the "special verdict" should have beem promptly recorded as such.

In any event, based on the answers, Quaker City correctly sought entry of a judgment in its favor as provided in Rule 58, Fed. F.Civ.P.[7] The answers, on the other hand, did not support Skil's position that the patent was invalid and not infringed. Therefore, Skil should have filed a Rule 50(b) motion for judgment notwithstanding *the verdict* since it wished to challenge the sufficiency of the evidence supporting the particular findings of the jury.

Finally, while "a specific verdict" seeks resolution of only *factual* issues under a precise reading of Rule 49(a), this court has not found error where a legal question has been included. Rather, since the answer to the legal question necessarily resolves any disputed underlying factual issues, we have undertaken to review the factual findings on which the legal conclusion is based, applying the substantial evidence standard. Connell v. Sears, Roebuck & Co., 722 F.2d 1542, 1550, 220 USPQ 193, 199 (Feb. Cir. 1983).

Turning to the action taken by the court here, we do not agree that the court was free to make a specific find-

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7. Rule 58 provides, in pertinent part:

Subject to the provisions of Rule 54(b): (1) upon a general verdict of a jury, or upon a decision by the court that a party shall recover only a sum certain or costs or that all relief shall be denied, the clerk, unless the court otherwise orders, shall forthwith prepare, sign, and enter the judgment without awaiting any direction by the court; (2) upon a decision by the court granting other relief, or upon a special verdict or a general verdict accompanied by answers to interrogatories, the court shall promptly approve the form of the judgment, and the clerk shall thereupon enter it.

ing under Rule 49(a) which *overruled* an implicit and inherent finding of the jury within a broader question. Rather, the court had to accept the jury's determination and could set it aside only if it were not supported by substantial evidence. However, this procedural irregularity did not affect the result here.

Inadequate Disclosure

The question of whether the disclosure of a patent satisfies the enablement requirement of §112, first paragraph, is a question of law. Raytheon Co. v. Roper Corp., 724 F.2d 951, 960, 220 USPQ 592, 599 n.6 (Feb. Cir. 1983). However, that issue may involve subsidiary questions of fact or of law. In this case, we are faced with both types of underlying questions. The first, whether the German Standard is necessary for an adequate disclosure, is a factual question; the second, whether it could be incorporated by reference, is a legal question.

Quaker City argues that the jury was aware of the argument and conflicting evidence over whether or not the unavailable German Standard was critical to enablement and presumably decided the matter in Quaker City's favor. Quaker City particularly points to the testimony of its witnesses, Drago and Berlinger, as providing the requisite "substantial evidence" in support of the answer.

Drago, a consultant for Quaker City in connection with gearing made in accordance with the Roth patent, testified as follows:

> Q. Mr. Drago, we've heard witnesses testify as to the inability to understand the Roth patent. Have you ever had any difficulty in understanding the Roth patent?
>
> A. No, sir.

Q. Have you ever had any difficulty in determining how to make a gear combination following the teachings of the Roth patent?

A. No, sir.

Q. Have you ever made any such combinations?

A. Yes.

Q. Well, let's change that. Have you ever designed any such combinations?

A. Yes.

Q. Have they been made?

A. Yes.

Berlinger, a mechanical engineer for Quaker City, testified to the following:

Q. Do you find in that patent a teaching of how to make a gear combination including a pinion and a gear?

A. Yes.

Q. Have you, by you, I mean you and Quaker City Gear Works, made gear combinations including a pinion and a gear in accordance with the teachings that you got from the Roth Patent?

A. Yes.

Q. Are the models of Exhibits 30, 31 and 32 made in accordance with the teaching of the Roth Patent?

* * *

THE WITNESS: Yes.

Quaker City's argument is that if the jury found the above testimony to be believable — and, according to Quaker City, the jury's answer to Interrogatory 11 indicates that it did — then the district court *must accept* the

jury's answer that the patent disclosure satisfies the requirements of 35 U.S.C. §112, first paragraph.[8]

[1] Under Quaker City's view, we could look *only* to evidence in its favor to determine whether "substantial evidence" supports the implicit factual finding that the German Standard was not "essential material." The law is clearly to the contrary.

In Connell v. Sears, 722 F.2d at 1546, 220 USPQ at 197, this court set forth the standard governing the granting or denial of a motion JNOV under Rule 50(b) as follows:

> To govern consideration of motions for a directed verdict and for judgment notwithstanding the verdict, guidelines consistent with the Seventh Amendment and the cited Rules have been set forth in the cases. [Citations omitted.]
>
> Under these guidelines, a court must: (1) *consider all the evidence;* (2) in a light most favorable to the non-mover; (3) drawing reasonable inferences favorable to the non-mover; (4) without determining credibility of witnesses, and (5) without substituting its choice for that of the jury between conflicting elements in the evidence. The court should not be guided by its view of which side has the better case or by what it would have done had it been serving on the jury. *If, after following those guidelines, the court is convinced upon the record before the jury that reasonable persons could not reach or could not have reached a verdict for the non-mover, it should grant the motion for directed verdict of for JNOV.* [Emphasis added.]

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8. We will assume that Interrogatory 11 is a complete determination with respect to §112 requirements, despite the failure of the jury to answer Interrogatory 12, which appears to be more precisely directed to enablement.

Cf. Universal Camera Corp. v. National Labor Relations Board, 340 U.S. 474 (1951). Thus, the substantial evidence standard requires a review of *all* of the evidence, in accordance with the above guidelines, in assessing whether the jury's presumed finding was reasonable.[9]

If we assume the jury wholly discredited the testimony of Skil's experts that the disclosure was not enabling, we must nevertheless, as the trial court did, take into account the admission by the inventor Roth that German Standard 58400 was necessary to design the wheel. Quaker City attempts to discount this admission on the basis that Roth was being interrogated on the corresponding German application, rather than the U.S. patent application. Skil counters with the explanation that the German application was used only as means for facilitating the cross-examination of Roth, which it contends was cumbersome at best, since it had to be conducted through a translator. Quaker City additionally discounts Roth's admission because he did not specifically refer to the "September 1963 draft." However, without question, Roth admitted that some standard was necessary, and the patent itself specifically identifies that material as a particular draft. In sum, Roth's testimony concerning the necessity of the standard negates the reasonableness of a conclusion that the standard was not essential for an adequate disclosure.

Quaker City's next set of contentions is that "all data of any significance from DIN 58400 are reproduced directly in the U.S. patent in suit," and that, in any event, the "well established German standards specifications closely parallel and are nearly identical to their U.S. counterpart," i.e., AGMA specification, 207.06, entitled "AGMA Standard System Tooth Proportions for Fine-Pitch Involute Spur and Helical Gear." Both these arguments must fail since the unavailability of the Sep-

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9. See Cooper, Directions for Directed Verdicts: A Compass for the Courts, 55 Minn. L. R. 903, 927-953 (1971).

tember 1963 DIN 58400 draft makes it impossible to confirm the assertions. Moreover, the concern expressed in the correspondence between Quaker City's German patent agent and U.S. attorney in 1965 convincingly negates Quaker City's position that the information is incorporated in the patent.

Finally, Quaker City challenges the district court's purported holding that "essential material" in a foreign document may not be incorporated by reference. Judge Green did note that the Manual of Patent Examining Procedure §608.01(p)(B) restricts the incorporation by reference of "essential material" to that found in (1) a U.S. patent or (2) an allowed U.S. patent application.[10]

Quaker City's argument is that the above referenced section was added to the MPEP *after* the pendency period of the Roth patent application. Skil's counter argument is that 35 U.S.C. §112, first paragraph, has always required an adequate disclosure.

[2] The restriction on incorporation by reference set forth in §608.01(p)(B) is immaterial to resolution of a case such as the present one, where an *unavailable* reference has been incorporated by reference. Incorporation by reference has never been permissible under 35 U.S.C. §112 of material necessary for an adequate disclosure which is unavailable to the public.

Since we affirm the judgment on the basis of lack of enablement, we will not address in detail the other grounds of invalidity raised by Skil. However, a number of errors appear from our review of the record. The court's instruction on a weaker or stronger presumption of validity and a different burden of proof depending on whether the PTO reviewed the best prior art is not in accordance with the precedent of this court. American Hoist & Derrick Co. v. Sowa & Sons, Inc., 725 F.2d 1350,

10. "Essential material" is defined as "that which is necessary to (1) support the claims, or (2) for adequate disclosure of the invention (35 U.S.C. §112)." M.P.E.P. §608.01(p)(B), at 600-35 (1983).

1360, 220 USPQ 763, 771 (Fed. Cir. 1984). The question of whether the cited references were prior art should not have been submitted to the jury nor instructions given, since it was undisputed that they were. Structural Rubber Products Co. v. Park Rubber Co., No. 83-1326, slip op. at 20 (Fed. Cir. Nov. 9, 1984); Nestier Corp. v. Menasha Corp.-Lewisystems Div, 739 F.2d 1576, 1579, 222 USPO 747, 750 (Fed. Cir. 1984). Further, the court's instruction on obviousness sugests that the jury should decide whether a person of ordinary skill would actually know of the prior art references, a clear error of law. Kimberly-Clark Corp. v. Johnson & Johnson and Personal Products Co., 223 USPQ 603, 610-14 (Fed. Cir. 1984). Understandably, the jury could have concluded that one ordinary skill in the art would be ignorant of references written in German and Japanese.

Finally, the court stated that it was using Rule 49(a) to resolve factual issues only, apparently believing that the legal issues of enabiement and obviousness were issues of fact. While it is not error to submit these issues to the jury if the trial judge wishes to do so, the instructions must identify in some clear manner what underlying factual issues the jury is expected to resolve. See Structural Rubber, slip op. at 28-32; Moore's, supra, §49.03[3] at 49-20 to 49-22.

II.

Attorney Fees

The basis for Skil's argument that this case is "exceptional" within the meaning of 35 U.S.C. §285 is that Quaker City breached its duty of candor to the U.S. Patent and Trademark Office by failing to disclose certain publications (the 1956 AGMA Standard 207.4 and the 1961 Thoen paper) to the examiner. While lack of candor or "fraud" can form a basis for an "exceptional case," we note that the jury, in answering Interrogatory #5, specifically found that Quaker City had *not intentionally*

failed to call these references to the attention of the U.S. Patent and Trademark Office. The difficulty with relying on this answer is that the jury erroneously held the references not to be prior art at all in Interrogatory No. 1.[11] In any event, in the interests of judicial economy, we have considered the record as a whole and ascertain no basis that would justify an award of attorney fees. Accordingly, we do not remand for the trial court to reconsider this matter.

Conclusion

In Appeal No. 84-634, we conclude the district court correctly granted Skil's motion for JNOV. In Appeal No. 84-649, we conclude that Skil is not entitled to attorney fees. Accordingly, the judgment is *affirmed.*
Affirmed.

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11. While a jury's fact findings common to a legal claim and an equitable defense are to be accepted by the court in ruling on the equitable matter, Beacon Theatres v. Westover, 359 U.S. 500, 508 (1958), resolution by the jury of equitable issues is questioned. See In re Yarn Processing Patent Validity Litigation, 472 F.Supp. 170, 173, 205 USPQ 758, 761 (S.D. Fla. (1979) (no right to jury trial on wholly equitable issues).

United States Court of Appeals for the Federal Circuit

QUAKER CITY GEAR WORKS, INC. and KARLHEINZ ROTH, *Appellants*,	:	No. 84-634 84-649
v.	:	
SKIL CORPORATION, *Appellee*.	:	

ORDER

A petition for rehearing and a suggestion for rehearing in banc having been filed in this case,

UPON CONSIDERATION THEREOF, it is Ordered by the court that the petition for rehearing be, and the same is hereby, Denied.

The suggestion for rehearing in banc is declined.

FOR THE COURT

George E. Hutchinson, Clerk

January 3, 1985
Date

cc: John W. Logan, Jr.
Clarence J. Fleming

FEDERAL REPUBLIC OF GERMANY
CERTIFICATION

The Siemens + Halske Aktiengesellschaft in Berlin and Munich has filed an application with the German Patent Office on January 17, 1963, for an invention patent under the title:

"Involute gear mating with a small number of teeth on the smaller gear".

The attached sheets are a correct and accurate reproduction of the original documents of this patent application.

Munich, November 4, 1963
The President of the German Patent Office
by: Wiedmann
Govt. Inspector in the German Pat. Off.

Document No: *S 83289 XII/47h*

Involute gear mating with a small number of teeth on the smaller gear

It is especially desirable for precision engineering to get along with small numbers of teeth on the gears. The production costs of a gear of given dimensions and given quality depend on the number of the individual teeth; the smaller the number of teeth, the lower the cost of the individual gear will be. If one decreases the number of the teeth on the smaller gear (pinion gear), then the number of teeth on the bigger gear is reduced to the same degree while maintaining the same gear ratio; thus, if instead of eight only two teeth are used for the pinion gear, then the number of teeth on the bigger gear is reduced by the factor of 4. A reduction in the number of teeth is, moreover, desirable in the case of a mating that is to provide a big step-down or step-up. Above all, for this type of application the reduction in the number

of teeth on the smaller gear leads to a further reduction in the overall structural size of the stage.

The invention concerns an involute gear mating with a pinion gear tooth number $Z1 \leq 5$. As is known, involute gears are preferred in transmission technology because they can be produced with straight-flanked tools and a change in the axial distance of the gears does not change the instantaneous transmission ratio, as is the case, e.g., with cycloidal and circular arc gear mating. As is known, the axes intersect in worm gear and helical gear mating. These gear systems are therefore not suitable for gearing designs with parallel axes, e.g., for those executed in *Platinenbauweise*. The transmission efficiency of a worm gear mating is usualy worse than the efficiency of an involute gear mating; a further disadvantage of the worm gear transmission is that a step-up is not possible. It is the problem of the invention to create an involute gear mating for parallel axes of the gears in which the number of teeth on the smaller gear (pinion) is so small that with the involute gearing matings according to the invention, transmissions can be realized in one stage which equal the possible transmissions of a worm drive without the strucutral size of the involute gear mating according to the invention fundamentally exceeding that of the worm drive. The gear mating of the invention is suitable for pinion gear tooth numbers under 5 and is characterized by the following features:

a) Such profiles are used for the smaller gear as have for the drive gear a small crown of tooth height and a big useful root of tooth depth, for the driven gear a big crown of tooth height and small useful root of tooth depth; the profiles of the tooth mating behave complementary to each other with reference to the flank involved in the power transmission.

b) A profile displacement is made such that for a gear mating for stepping down a rotary motion

the smaller gear (pinion) has a positive profile displacement, for a gear mating for stepping up, on the other hand, the smaller gear (pinion) has a negative profile displacement.

c) Crown shortening or root of tooth decrease and profile displacement are so adjusted to each other than the length of contact (with reference to the center line and with reference to the driving gear) for the most part lies on the side of the contact end.

d) The contact angle α_O is selected for a gear mating for stepping down of 15° to 25°, while for a gear mating for stepping up a contact angle of 25° to 35° is selected.

The invention is discussed with reference to the drawing in three embodiments.

Fig. 1 shows the reference profile of the normal section (rack profile) of a one-toothed pinion,

Fig. 2 shows the reference profile of the normal section (rack profile) of a two-toothed pinion,

Fig. 3 shows a one-toothed pinion in perspective,

Fig. 4 shows a two-toothed pinion in perspective,

Fig. 5 and Fig. 6 show the reference profile of two complementary profiles for stepping up,

Fig. 7 shows a gear mating for stepping up,

Fig. 8 shows an efficiency diagram of the transverse section for contact beginning and contact end.

In the profile of Fig. 1 the module m, as usual, is taken as a standard; all dimensions except for the degree designations are therefore to be multiplied with the moduie in mm. The line MM is so located that the tooth thickness = the space width = the half pitch $t_O/2$. The

pitch t_O amounts to 3.14159 module. The tooth crown is 0.25 module high, the root is 1.1 module deep; the tip clearance is 0.2 module.

A gear helical-toothed according to these measurements in the hob method is shown in Fig. 3. The tooth width is about 6 module, the angle of skew on the pitch cylinder $\beta_O = 15.2°$. The smallest angle of skew necessary for the *Ueberwachung* (monitoring, control, inspection??) is calculated according to the formula $\sin \beta = \pi m/2b$ (m = module, b = tooth width); in order to keep the axial force of the gears small, a small angle of skew is desirble; such a one also works out favorably on the flank shape of the gears in the production with gear hobbers.

The lead, i.e., the pitch circle arc between the two pitch cylinder generatrices through the points of intersection of a flank line with the two faces of the toothing, is so chosen that a ratio of lead ϵ of the mating of $\epsilon > 1$ results. As mating profile a standard profile can be used and with particularly good results the 58 400 for precision engineering; here, with a lead of a half pitch $t_O/2$ on a gear with 30 teeth and a spiral angle of $\beta_O = 15.2°$, a lead ration of $\epsilon = 1.1$ results.

Precision engineering standa.d profile 58400 behaves, with reference to the flanks involved in the power transmission, complementarily to the reference profile of Fig. 1, i.e., the pinion gear of Fig. 1 or 3 has a small crown and a large root, while the gear meshing with this pinion relative to parts involved in the power transmission has a large crown and a small root. Thus in standard profile 58400 a part of the flank of the root available for the power transmission in the gear mating in question is not utilized; this unused part can, however, be made useful if used with an additional gear. Of course, it is also possible to provide a reference profile that has a small root to begin with. Such a gear would have the advantage

of the somewhat greater solidity and the disadvantage that it can be mated only with the pinion gear as per Fig. 1 or 3.

The reference profile of Fig. 2 has a somewhat larger crown than that of Fig. 1, namely, of 0.4 module, and a somewhat greater tip clearance (root radius tooth fillet) of 0.3 module. The therewith associated pinion gear (Fig. 4) likewise has a lead of a half pitch $t_O/2$, the minimum tooth width being about 6 module; the spiral angle is 15.2°. The pinion of Fig. 4 can likewise be mated with a helical gear that is produced according to precision engineeering standard profile 58400. The reference profile of Fig. 2 is likewise a complementary profile to precision engineering standard profile 58400. It is possible, though a little less advantageous, to use a helical gear according to DIN 867 as mating gear.

Fig. 5 shows a reference profile for gearing for stepping up a rotary motion. In it, m designates the module, to the pitch $\alpha_O = 30°$, the pressure angle $S_K = 0.1$ m the tip clearance. The profile reference line MM, indicated by dash-dot line, is so located that tooth thickness and tooth space are equal. The point P marks the end of the driving flank of the rack profile. Fig. 6 shows a reference profile complementary to the reference profile of Fig. 5. The designations are the same as in Fig. 5.

A gear mating composed of helical gears corresponding to the reference profile of Figs. 5 and 6 is shown in Fig. 7. The smaller gear (pinion gear 1) has six teeth, while the gear 4 has 60 teeth. Of individual teeth of pinion gear 1 front surfaces 2 and back surfaces 3 are indicated, of individual teeth of the gear 4 front surfaces and back surfaces 6 are indicated. The ratio of lead of a *Schichtelement* (layer/coating element?) is 0.7, taking into consideration the ratio of lead, the entire overlap amounts to 1.2. The direction of rotation of the gears 1 and 4 is indicated by the arrows 7 and 8; this results in a stepping-up of a rotary motion.

The length of contact E1, E2, E3 lies, with reference to the line M1, M2 for the greater part on the right side, i.e., on the side of the contact end. At the beginning of the tooth contact (shock friction) the teeth surfaces still rub only a little on each other, since the point E1 lies close to the center line M1, M2, while at the contact end (pulling friction), at point E3 the stronger sliding of the tooth surfaces on each other does less damage. In Fig. 8, the instantaneous degree of efficiency η over friction value μ for a normal straight gear mating and for a *Schichtelement* of the gear mating according to the invention is shown. Although the number of teeth of the gear mating produced according to the invention is smaller, the efficiency for the transmission is better. The curve paths z1/z2 = 60/6 are valid for a *Schichtelement* of the gear mating of the invention according to Fig. 7, the curve parts z1/z2 = 80/8 are valid for a normal straight gear mating with 80 and 8 teeth respectively. The curve paths for the contact beginning are solid, while the curves for the contact endings are dashed. As can be seen from the representation, the curve paths for the gear mating of the invention according to Fig. 7 (are) closer together than in any previous normal gear mating; above all, the decrease in the degree of efficiency under increasing friction value is not so great with reference to the contact beginning and is always far above zero. This represents a great advantage because a jamming of the gears at the beginning of contact in the embodiment of the invention does not occur even with friction value μ = 1.0. It is shown, therefor, that the gearing of the invention is especially suitable for overcoming difficult operating conditions under which the friction value is especially high as a result of infrequent maintenance of the gearing or because of the presence of sand or dust in the atmosphere. Valid here also are the diagrams for a *Schichtelement* of the frontal section (*Stirnschnitt*).

Claims

1. Involute gear mating for pinion tooth numbers z = 5, characterized by the combination of the following characteristics:

   a) Such profiles are used for the smaller gear as have for the drive gear a small crown of tooth height and a big useful root of tooth depth, for the driven gear a big crown of tooth height and small useful root of tooth depth; the profiles of the tooth mating behave complementary to each other with reference to the flank involved in the power transmission.

   b) A profile displacement is made such that for a gear mating for stepping down a rotary motion the smaller gear (pinion) has a positive profile displacement, for a gear mating for a stepping up, on the other hand, the smaller gear (pinion) has a negative profile displacement.

   c) Crown shortening or root of tooth decrease and profile displacement are so adjusted to each other that the length of contact (with reference to the center line and with reference to the driving gear) for the most part lies on the side of the contract ending.

   d) The contact angel α_O is selected for a gear mating for stepping down of 15° to 25°, while for a gear mating for stepping up a contact angle of 25° to 35° is selected.

2. Gear mating as described in Claim 1 for pinion tooth numbers under 3, characterized by the fact that the overlap ratio of a *Schichtebene* (layer plane??) of the gear mating is selected to be under 1 and a overlap ratio of the total mating

greater than 1 is obtained by using a helical gearing.

3. Gear mating as described in Claim 1 or 2 for stepping down a rotary motion, characterized by the fact that the standard precision engineering profile 58400 is used as reference profile.

Fig.1

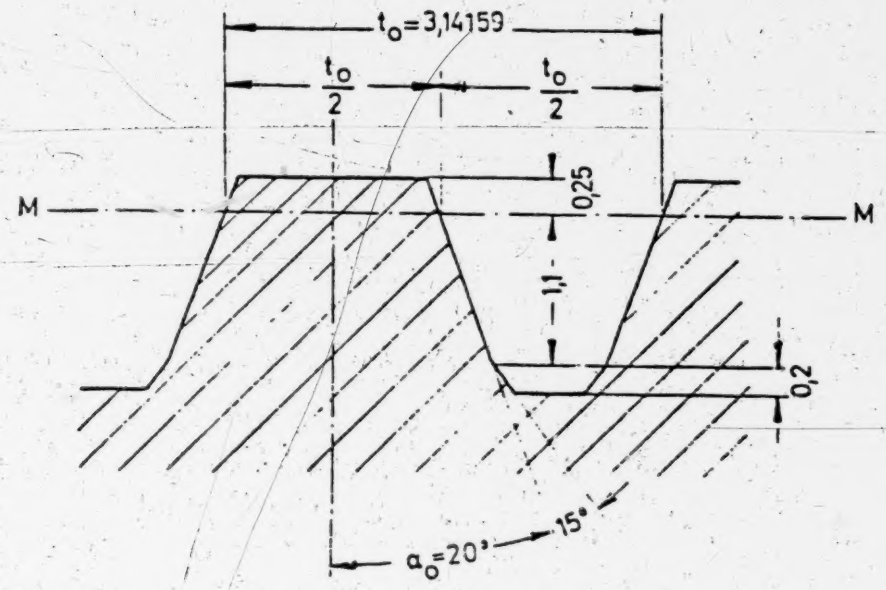
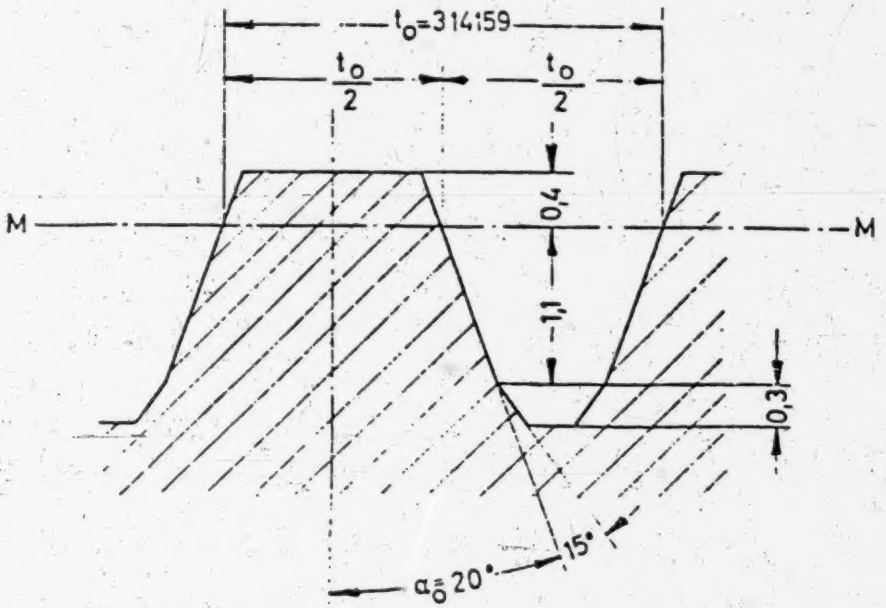

t_o=3,14159
$\frac{t_o}{2}$
$\frac{t_o}{2}$
M
M
0,25
1,1
0,2
α_o=20°
15°

Fig.2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M
0,4
1,1
0,3
α_o=20°
15°

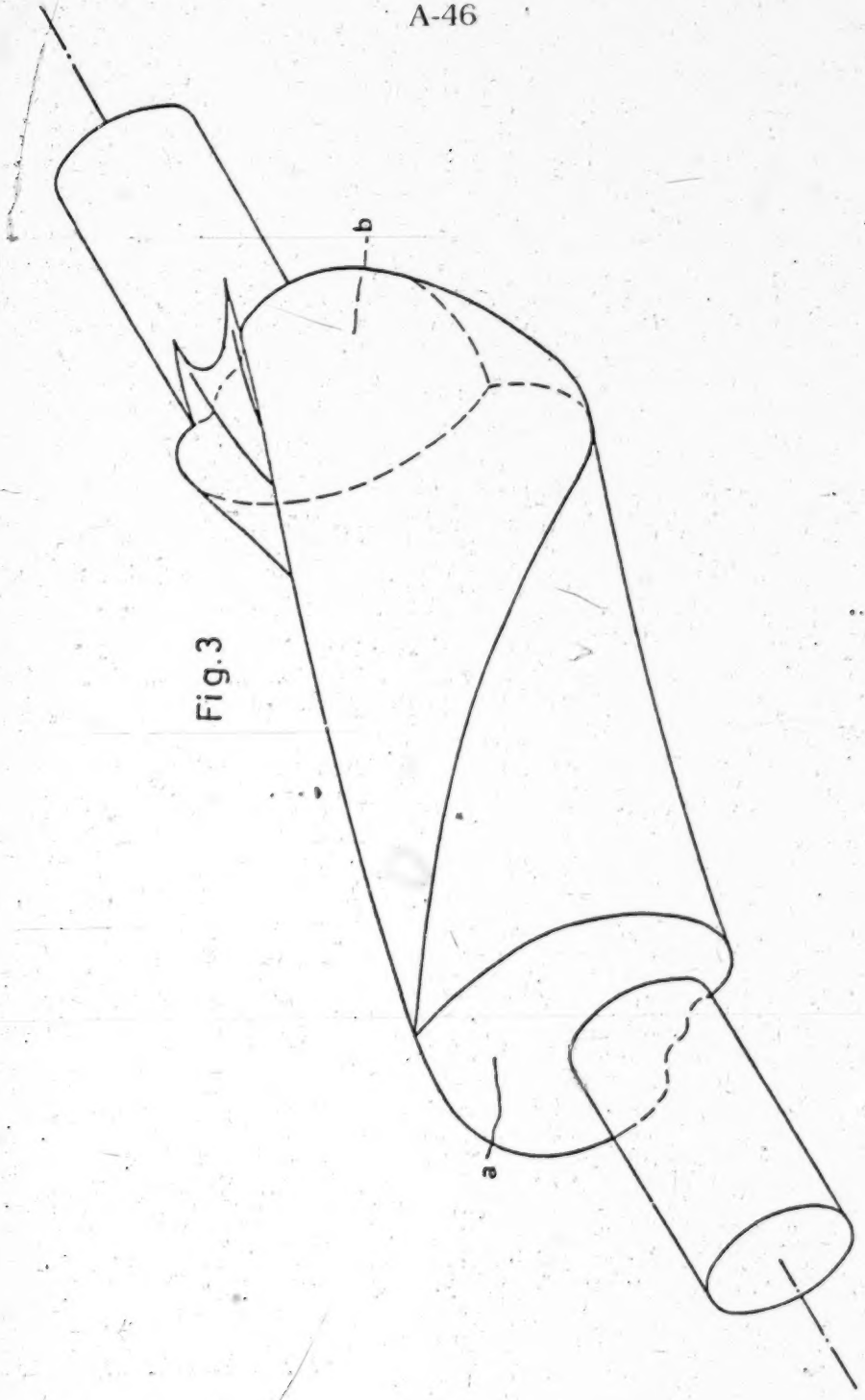


Fig.3

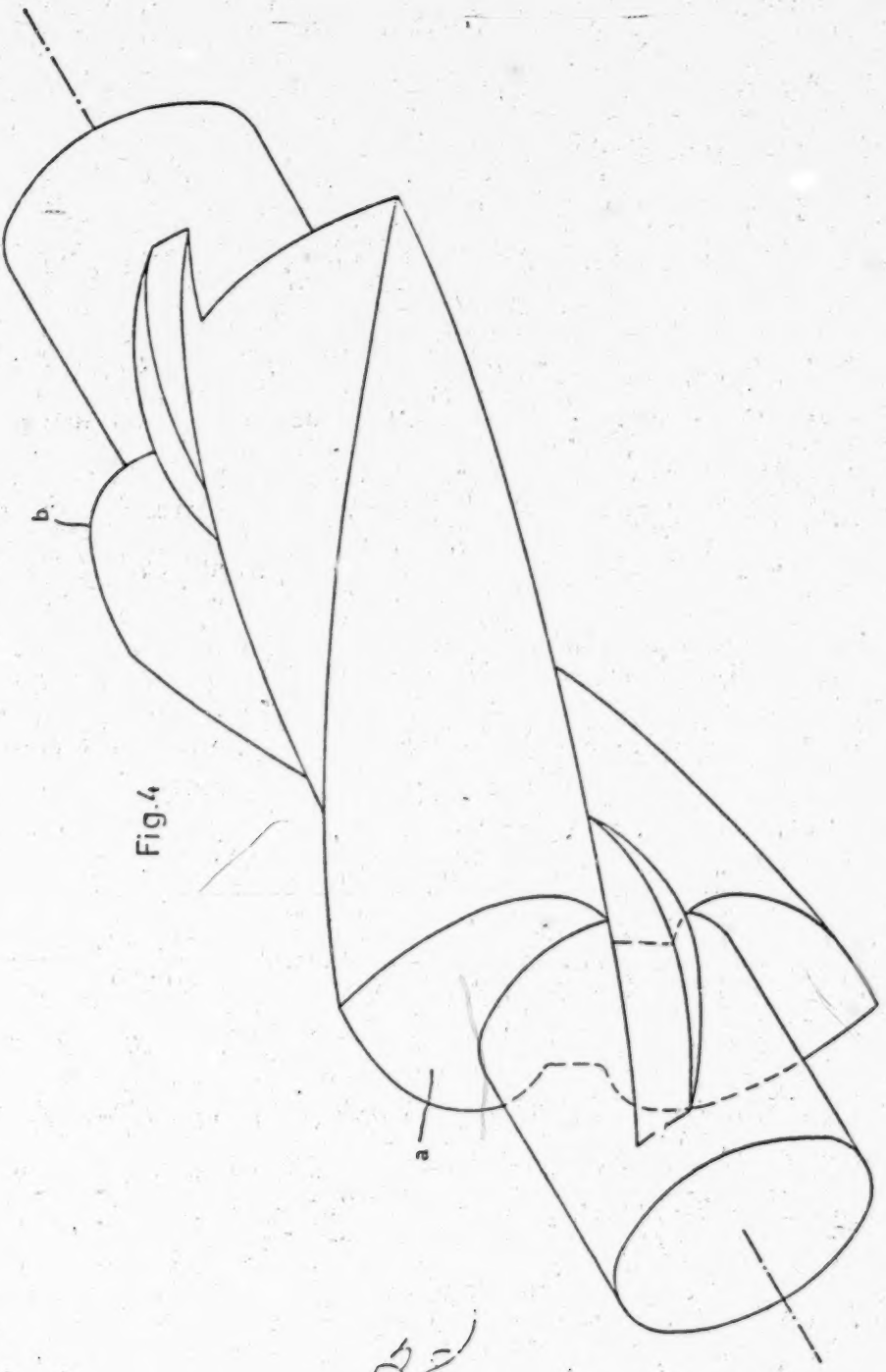
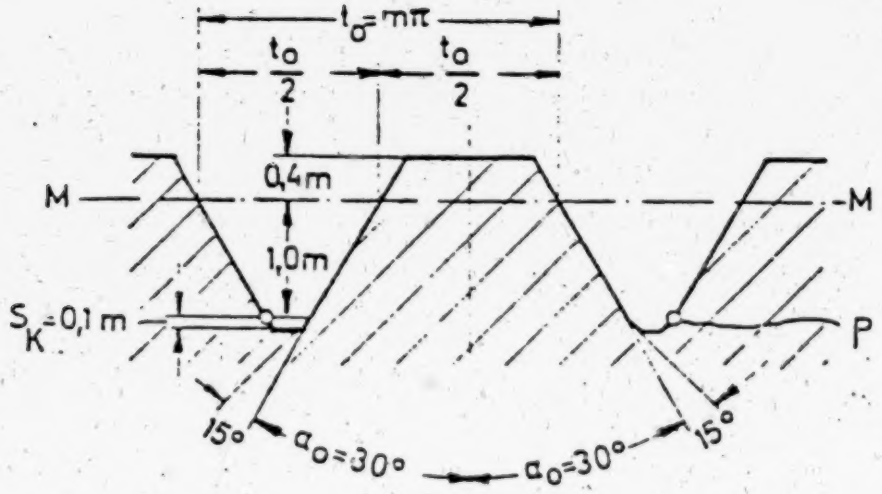


Fig.4

22

Fig.5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$\frac{t_o}{2}$
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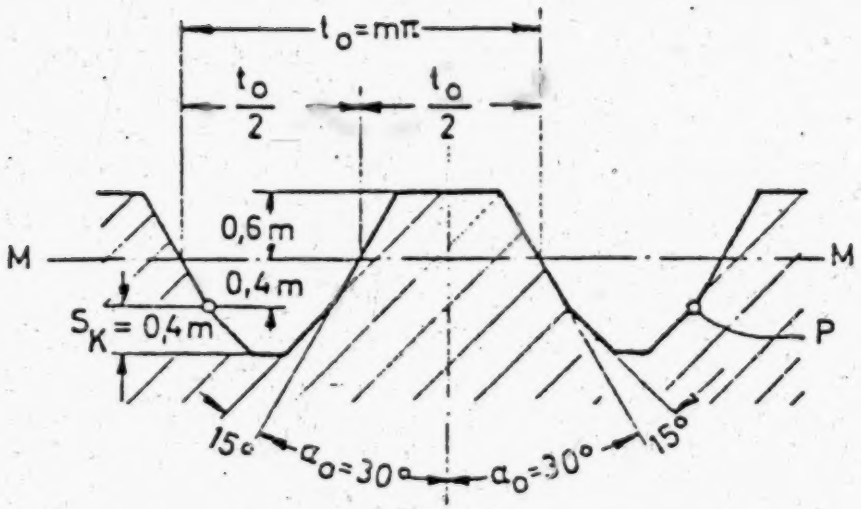
M
-M
1,0m
S_K=0,1 m
P
15°
a_o=30°
a_o=30°
15°

Fig.6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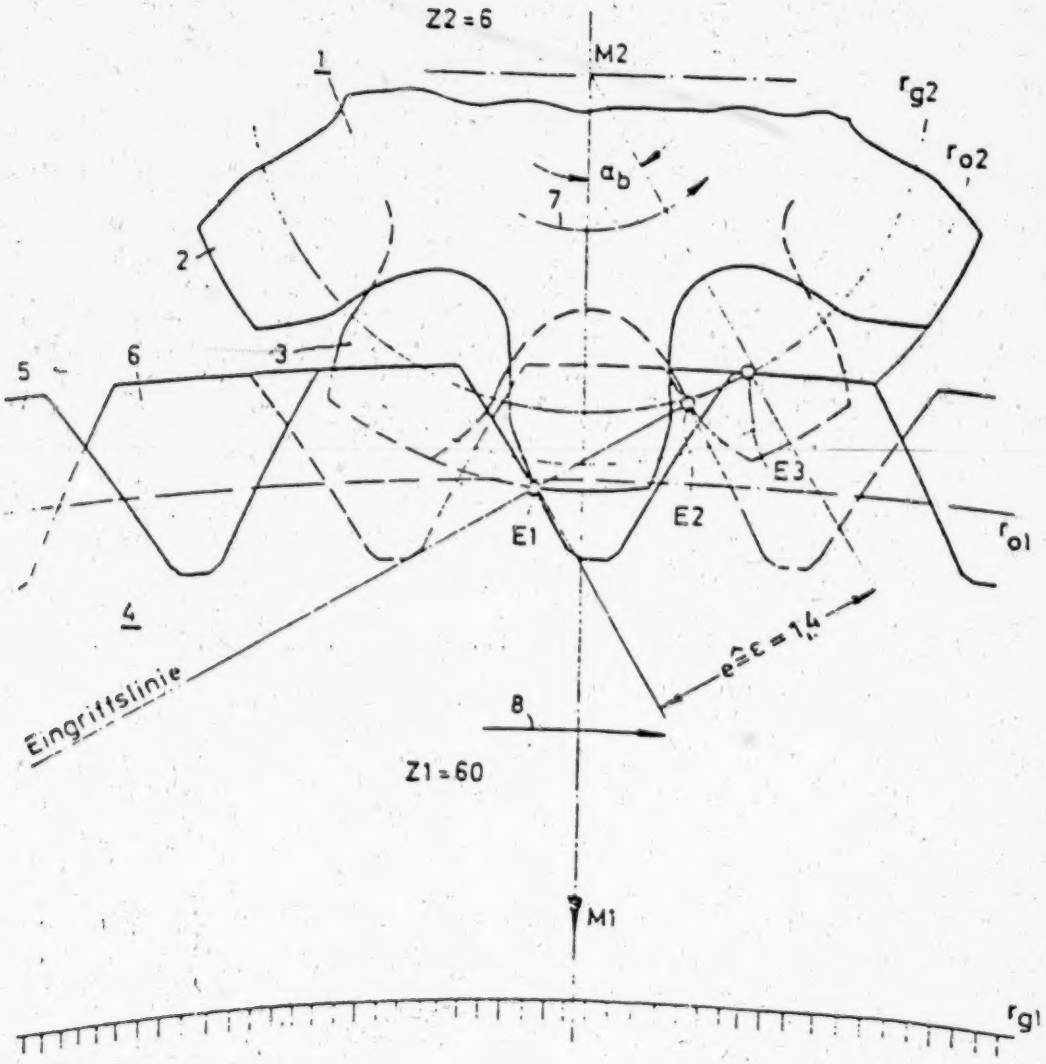
S_K = 0,4m
P
15°
a_o=30°
a_o=30°
15°

Fig.7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M2
1
r_{g2}
r_{o2}
α_b
7
2
3
5
6
E3
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8
Z1 = 60
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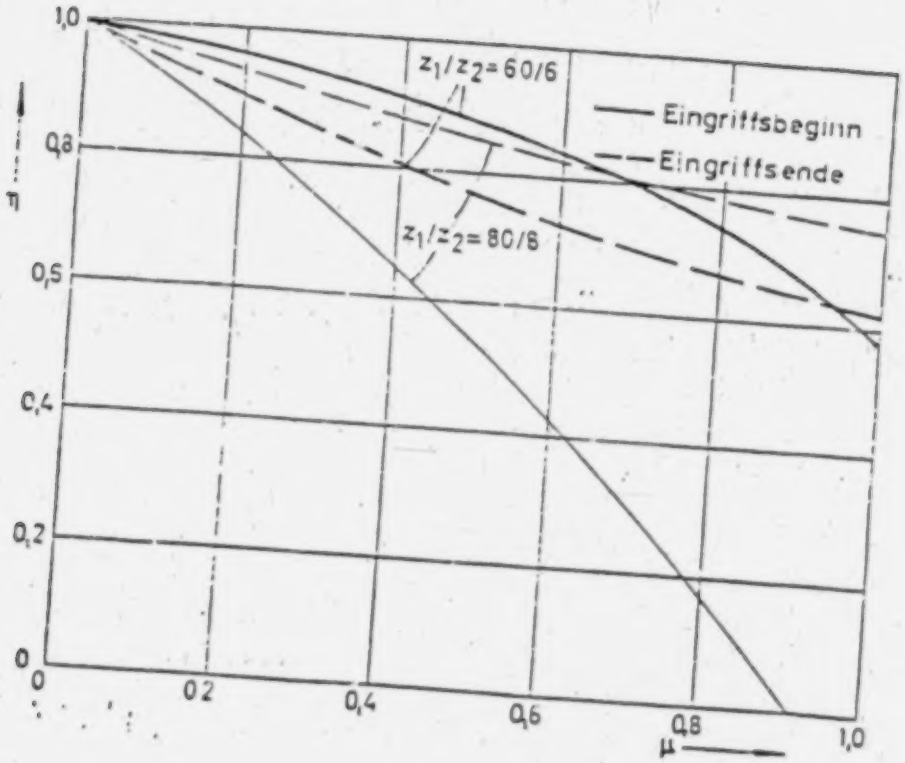
Fig.8


1,0
0,8
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BERLINGER DIRECT — called as a witness by Quaker City

Q. What is the business at Quaker City Gear Works?

A. Quaker manufactures custom precision gearing for small gearing, probably a quarter of an inch in diameter, up to about 39 inches in diameter and also gear reduction boxes.

Q. How long have you been employed by Quaker City Gear Works?

A. Since 1961, March.

Q. Could you trace your positions with Quaker City Gear Works from March of 1961 to the present?

A. Certainly. In March of 1961, I started in the shop by learning how to set up and run gear cutting machinery.

Q. Now, this was shortly after you graduated from college?

A. That is correct, it was. From there I moved into the Engineering Department for a few years, moved into the sales function of the company and did quite a bit of sales work in the latter part of the sixties and became General Manager in 1968 and President in 1971.

Q. What type of work did you do while you were in the Engineering Department?

A. I made many of the gear calculations that are necessary to properly manufacture and inspect gearing of various types.

Q. Did you do any design work?

A. Yes, I did.

Q. What type of design work did you do while you were in the Engineering Department at Quaker?

A. We occasionally would get a requirement from a customer to design and build the gear reduction system, which would be, let's say, several gears connected together to achieve a certain purpose. The stree levels of the gearing, the loads on the bearings had to be calculated. The sizes and dimensions of those gears had to be

calculated and the manufacturing processes had to be written and then manufactured in the shop.

Q. Is that the type of work that you did?

A. Yes, it is.

Q. Did you stop all engineering work after you got out of the Engineering Department of Quaker?

A. No, I didn't. I continued my engineering involvement to some extent, although not as great an extent after I got involved in sales and management of the company.

Q. To what technical societies do you belong?

A. The one I belong to is the American Gear Manufacturers Association, commonly known as AGMA.

Q. And what is AGMA?

A. AGMA is the American Gear Manufacturers Association, a group of individuals and companies in America with some foreign members whose major purpose it is to develop and devise gearing standards and to promulgate those standards throughout the industry in America.

Q. What positions have you held with the AGMA?

A. Excuse me. I participated in the Marketing Council, the International Advisory Council. I was the Chairman of the Fine Pitch Gearing Committee of AGMA for five years and I am presently on the Board of Directors of that group.

Q. What technical papers, if any, have you presented?

A. I have presented two technical papers.

Q. And what was the subject matter of them?

A. The subject matter was the Engineering End Uses, the Engineering End Uses of the Roth Invention.

Q. When and where were they presented?

A. The first paper was presented in 1975 to the American Gear Manufacturers Association in Montreal and dealt with the engineering of Evoloid gearing; and the second was presented to the National Conference on Power Transmitting here in Philadelphia in 1978.

Q. And that dealt with what?

A. That dealt with the uses of Evoloid — or excuse me, of Roth grearing.

Q. I was just going to comment on your use of the term "Evoloid."

A. I'm sorry.

Q. What patents, if any, have been issued to you in your name?

A. I have approximately five patents in my name, and they deal with mechanisms in valve actuators and the general form of valve actuators.

Q. Do valve actuators include gearing?

A. Yes, they do

* * *

Q. Now, Mr. Berlinger, I would like you to refer to what has been identified as Plaintiff's Exhibit 1, the Roth 736 Patent.

Have you read that patent or studied that patent before?

A. Yes, sir.

Q. Do you find in that patent a teaching of how to make a gear combination including a pinion and a gear?

A. Yes.

Q. Have you, by you, I mean you and Quaker City Gear Works, made gear combinations including a pinion and a gear in accordance with the teachings that you got from the Roth Patent?

A. Yes.

Q. Are the models of Exhibits 30, 31 and 32 made in accordance with the teaching of the Roth Patent?

MR. FLEMING: Judge, another objection, please, on absolute lack of foundation for that question.

THE COURT: Overruled.

THE WITNESS: Yes.

* * *

Q. All right. What is this German Industrial Standard business that is referred to there?

A. It is a German Standard very similar to American Standards with regard to rack forms such as that hob that we passed through the jury.

Q. The patent contains several references to this German Industrial Standard 58,400.

A. That's correct.

Q. It appears in here about four or five times.

A. Yes.

Q. It says a September '63 draft, is that correct?

A. I'd have to look, sir.

In Calim Five, yes, it does draft, September 1963.

Q. Well, look in Column 3 for example, down about line 37 it mentions it again, doesn't it?

A. Yes, sir.

Q. Have you ever seen that 1963 draft?

A. I've seen 58,400. Whether it was that draft, I can't recall.

Q. So you can't testify that you have ever seen the September 1963 draft, can you?

A. No, sir.

Q. How can you —

A. Not that draft.

Q. Well, that is what the patent refers to.

A. I've looked at a lot of drafts, Mr. Fleming. I can't remember the draft date. I am sorry.

Q. But you can't state positively here now to this jury that you have seen the September '63, can you?

A. No, sir.

Q. Then how can you say it's similar to some other standard in the United States, if you have never seen it?

A. I cannot say for sure that I have seen the 58,400 draft September 1963. I have examined other drafts of 58,400 many times.

Q. Well, if you haven't seen the September '63 draft, you don't know what it — you don't know what it shows, do you?

A. I don't know what it shows?

Q. That's right.

A. I have a very good idea of what it shows.

Q. But that is speculation; isn't it?

A. From my experience in the gear field, I would say that I might be quite accurate at determining —

Q. But it is speculation. You can't tell these jurors for sure what is in a document that you've never seen, can you?

A. I don't know whether I have ever seen it or not.

Q. Well, then, you can't sit here and tell them that it is similar to something else if you don't know if you have ever seen it; isn't that true?

A. Yes.

Q. All right. Now, you said that you have seen other drafts.

Is this a standard that is used — is it in Europe?

A. Yes.

Q. Skil doesn't sue [sic use] that German business to make its gears, does it?

A. It doesn't elect to.

Q. Does Skil use it to your knowledge? Yes or no.

A. No, sir. To my knowledge it does not use it.

Q. All right. Does your company use it either?

A. No.

Q. Do you use the AGMA standards?

A. That's correct. Yes, we do.

Q. Don't you understand that is what Skil uses too?

A. They may or may not, but I would assume they'd use the American standard.

Q. And AGMA stands for the American Gear Manufacturers Association; isn't that right?

A. Yes, sir.

DRAGO DIRECT EXAMINATION — called as a witness by Quaker City

BY MR. LOGAN:

Q. Would you state your full name, Mr. Drago?

A. Raymond J. Drago.

Q. And your address?

A. 24 Marlboro Lane, Glen Mills, Pennsylvania.

Q. What was your educational background after high school?

A. I have a Bachelor of Mechanical Engineering from the City University of New York. I have a Master's in Engineering from the Pennsylvania State University, and a Master's degree in Structural Engineering from Drexel University.

Q. By whom are you presently employed?

A. By the Boeing-Vertol Company in Philadelphia.

Q. When were you first employed by Boeing-Vertol?

A. 1967.

Q. And have you been employed ever since that date by Boeing-Vertol?

A. Yes, I have.

Q. What have been your duties at Boeing-Vertol from 1967 to the present?

A. Well, during the first year with the company, I participated in a familiarization type training program, but since that time, after the first year, I've been in the Advanced Power Train Drive Systems, Research and Development Group. In that group it's been our responsibility to do all of the research and development for that division and for the rest of the Boeing Company in the area of mechanical power transmission and to provide assistance with other design groups.

Q. Yes. What type of work do you do with your R&D group for Boeing?

A. The type of work that we do is related to mechanical power transmissions. We investigate various phenomena related to mechanical power transmissions, including gear tooth forms, strength analysis, durability analysis, design, materials, metallurgy.

Q. Is this gear drive for helicopters?

A. In part, yes.

Q. Do you work in gearing primarily in the helicopter area?

A. My work for Boeing is largely in the helicopter area, although we encompass many other fields.

Q. Now, you also do consulting you said with other divisions of the Boeing Company?

A. That's correct.

Q. What type of consulting do you do or what type of product do you consult with for these — with these other divisions?

A. Well, Boeing is a large company and they manufacture a wide variety of products. Some of the areas that I've been involved in are Marine drives for military ships, for commercial ships. The jet foil that is used from Hong Kong to the mainland, for example, I've worked on that drive system. I worked on the windmills that are currently being sponsored by NASA. And I've worked on some more mundane things, like models for windmills, drives for torque tools that are used to drive down large nuts in assemblies, things of that nature.

Q. And they're examples of what you've done?

A. Yes, sir.

Q. Do you also have an outside consulting business?

A. Yes, I do.

Q. What is the function of your outside consulting business?

A. To provide assistance to various clients in various areas of mechanical power transmission. The consulting business is limited primarily to mechanical power transmission, gearing, if you will.

Q. Is that consulting done with Boeing's knowledge?

A. Yes, sir, it is.

Q. Is that a usual practice for a company to permit an engineer to do outside consulting?

A. I would say it is not usual, no.

Q. Are you a registered professional engineer?

A. Yes, I am. I am licensed in Pennsylvania.

Q. Now, Mr. Drago, I would like you to refer to what has been marked as Plaintiff's Exhibit 38.

A. Yes.

Q. And under the area of publications there are listed a total of 36 publications; is that correct?

A. 36 at this time, yes.

Q. Are these papers papers that you have prepared, publications that you have prepared?

A. Yes, sir.

Q. And for whom have you prepared them?

A. Many different areas.

Q. What types of technical societies have they been presented to or prepared for?

A. The majority of the technical papers have been prepared for the American Gear Manufacturers Association. I believe that accounts for probably 10 or 11 or something of that nature. Several other societies, the American Society of Civil Engineers, European Rotocraft Forum, American Helicopter Society, American Institute of Aeronautics and Astronautics, International Federation for the Theory of Mechanisms in Machines, American Society of Mechanical Engineers.

Q. Now, these publications cover the period from 1972 through 1982; is that correct?

A. That is correct.

Q. In addition to your work as a consultant and your work for Boeing, did you have any teaching activity?

A. Yes, I do.

Q. What is your teaching activity?

A. I teach seminars in various aspects of gear design.

Q. And where have you taught them?

A. Various locations. I teach at the University of Wisconsin in Milwaukee, Wisconsin. I have taught at Boeing and I'm scheduled to teach several, actually in the next couple of weeks.

Q. At — where will these several be?

A. Ford Motor Company in Livonia, Michigan, has requested that I present a noise seminar there. I am currently negotiating with a local company to present the fundamentals of gear design seminar and there are ne-

gotiations underway with the Navy Department in Warminister to present the course to their personnel.

Q. And how many times have you presented this seminar at the University of Wisconsin?

A. The one in two weeks will be the third.

Q. And how many hours long is this seminar, how many hours of teaching?

A. The ones at the University of Wisconsin are actually two different seminars. One is in the fundamentals of gear design and this requires three 8-hour days.

The second one that I have presented there is in gear system design for minimum noise and that requires two 8-hour days.

Q. Have you also been requested to write a chapter for a technical book that is to be published?

A. Yes, I have.

Q. And who is the publisher?

A. McGraw Hill.

Q. Are they a leading publisher of engineering textbooks and — for the college and professional level?

A. Yes, they are.

Q. And what is the title of the chapter?

A. Helical gearing.

Q. And when will that book be published?

A. My first draft is due sometime this summer and I really don't know when the book will be published. Probably within the next year or two. It takes quite a while for a technical book to come out.

Q. Are you a member of any technical associations?

A. Yes, I am.

Q. Which ones?

A. American Society of Mechanical Engineers and the American Gear Manufacturers Association.

Q. Have you served in any technical committees of the American Gear Manufacturers Association?

A. Yes, several.

MR. LOGAN: Your Honor, at this time I would like to offer Mr. Drago as an expert.

THE COURT: Do you wish to examine first?

MR. FLEMING: Yes, sir, I'd like to, please. (Cross-Examination on voir dire.)

BY MR. FLEMING:

Q. Mr. Drago, just looking here at some of your publications for example, number one, the title is Design, Fabricate, Test and Evaluate Spiral Bevel Support Bearings. Does that have to do with bearings?

A. It has to do with bearings that support spiral bevel gears, a gear type commonly used in helicopters.

Q. You agree that the subject matter in this lawsuit has to do with fine pitch gears?

A. The subject matter of this lawsuit, as I understood, had to do with the Roth Patent.

Q. Don't you — do you understand the term "fine pitch gearing"?

A. Certainly.

Q. Does the Roth Patent relate to "fine pitch gearing"?

A. The Roth Patent relates to gearing.

Q. Does it relate to "fine pitch gearing"? That calls for a yes or no answer.

A. Yes, it does.

Q. Do any of your papers here pertain to "fine pitch gearing"?

A. Yes, I would say they do.

Q. Well, identify them by number.

A. Any paper that deals with gear theory, deals with fine or course pitch.

Q. I am asking you if any of these papers deal with the subject matter and discuss in the paper "fine pitch gearing"?

A. I don't believe any of the papers specifically discuss "fine pitch gearing" per se.

Q. Not on one of the 36, correct?

A. As far as I can remember, that is correct.

Q. All right. What kind of work, if any, have you done in fine pitch gearing?

A. I have done some work on tool torquing drives, fuel controls, small gear motors and, of course, some of the evoloid designs that I've worked on, Roth patent designs that I've worked on.

Q. Have you consulted previously for the Quaker City Gear Works?

A. Yes, I have.

Q. Have you done any work on power tools, other than these torque drills you referred to?

A. Not that I can recall.

Q. In those torque tools that you referred to, do they have a pinion gear in there?

A. Yes, sir.

Q. What's the number of teeth on the pinion?

A. In a specific application?

Q. What's the lowest number of teeth that you have ever worked on in that application?

A. Probably two or three.

Q. This is, of course, a helix?

A. Yes.

Q. This work that you've done, this consulting work that you've done for Quaker, what does that entail?

A. A variety of products, including design of some of the gear boxes that they have sold to various clients.

Q. And that involved helical gearing?

A. Yes, sir.

Q. How many teeth on the pinion there?

A. Various numbers, from very low numbers, like three or four, up to 20 or 30 or 50.

Q. I understand from your testimony that a large part of your work with the Boeing Company is with respect to these helicopters, correct?

A. That is correct.

Q. That is not fine pitch tooth gearing there, is it?

A. The mechanical power part of it is not. The control part of it is.

MR. FLEMING: Well, Judge, there is a question of going to the weight. I don't think the witness has got

much experience in the particular subject matter of this lawsuit, but I will move that he not be permitted to testify.

Thank you, sir.

THE COURT: You may examine him.

Is this witness an expert basically in gearing?

MR. LOGAN: Yes, sir, in gearing and gear design and testing gears.

* * *

Q. Now, if one wanted to make a gear of the Roth patent, where would one go to get the necessary information?

A. There are two sources of information. Number one, we would assume that someone who was going to design a gear was a gear designer and had some background in that field, so he would certainly draw on his own knowledge.

Number two, for those items, specific to the Roth design, he would have to go to the Roth patent.

Q. Does the Roth patent teach a gear designer everything he would have — need to make a gear, a described in the Roth patent?

A. No, sir.

Q. What does it not teach him?

A. It doesn't teach him everything else he needs to know about gear design, strength analysis, durability, basic geometry. For example, it doesn't teach him what diametral pitch means.

Q. Let's say we have a competent gear designer and he wants to make a gear in accordance with the Roth patent, can he go to the Roth patent and get everything he needs to know that is not in his own present knowledge, to design a gear of the Roth patent?

A. If he were a competent gear designer, yes, sir.

* * *

Q. Mr. Drago, we've heard witnesses testify as to the inability to understand the Roth patent. Have you ever had any difficulty in understanding the Roth patent?

A. No, sir.

Q. Have you ever had any difficulty in determining how to make a gear combination following the teachings of the Roth patent?

A. No, sir.

Q. Have you ever made any such combinations?

A. Yes.

Q. Well, let's change that. Have you ever designed any such combinations?

A. Yes.

Q. Have they been made?

A. Yes.

Q. How many?

A. I would be hard pressed to say exactly, but I would imagine a couple of dozen.

Q. Did you ever have any problem understanding claims one and three of the Roth patent?

A. No, sir.

Q. Could you take a gear combination and by proper inspection and calculation determine whether or not that gear combination came within the scope of claims one to three of the Roth patent?

A. You mean, could I take a physical piece of hardware and determine it?

Q. And by proper inspection.

A. If I had proper inspection equipment, certainly.

Q. Does the German Roth patent in any way, in your opinion, reflect on the correctness of the equation that's contained in claim one of the Roth patent?

MR. FLEMING: I am going to object to that.

ROTH DIRECT via interpreter — called as a witness by Skil

Q. I'm not clear as to whether the 58,400 refers to the pinion or the wheel.

A. To the wheel.

Q. Is it necessary to have information from this 58,400 standard to design the wheel?

A. Yes, this is necessary.

* * *

ROTH DIRECT — called as a witness by Skil

Now, referring to the United States patent, doesn't this mean that the sine of the helix angle must be less than this value?

A. Yes.

Q. Doesn't this formula mean that the sine of the helix angle must be greater than or equal to this value?

A. In the German patent, in the German patent there is on the right side given a fraction and in the U.S. patent there is given a fixed value.

This says in the American U.S. patent is given a limited value and how to interpret this, it is done in the German application, through an example.

May I read it, the German patent?

Q. I only want him to read from what is in the record of this case.

MR. FLEMING: Judge, I should have offered into evidence Defendant's Exhibit 25 which is the foil wrapper of the patent.

THE COURT: All right.

(Defendant's Exhibit 25 received in evidence.)

THE WITNESS: Page 19.

(Witness reading in German.)

THE WITNESS: The interpretation of the formula is given to an example and through the text by the text in the text.

BY MR. FLEMING:

Q. Why is the — aren't these two formulas opposite to each other?

A. The U.S. patent is dealing with a further, broader area and the German with a limited, more limited area.

THE INTERPRETER: I am sorry. The U.S. patent has a smaller, or deals with a smaller area.

Q. Does the U.S. patent establish a certain limit for the helix angle?

A. No, a deeper limit, lower limit.

Q. Doesn't the U.S. patent say that the helix angle must be less than the value?

A. Yes, the optimum helix angle.

Q. Doesn't the United States patent say that the helix angle must be less than it's value?

A. Yes, smaller than the value, up 1.5.

Q. Doesn't the German patent say that the helix angle must be greater than the same value?

A. The German gives us a bigger area for the helix angle.

Q. How does that make any sense for the U.S. — United States patent to establish — I will rephrase the question. How does it make —

MR. LOGAN: Your Honor, objection. The German patent is not in issue here. And he's asking him as to the scope of the German patent. The Germans are not involved in this and it's not at issue.

MR. FLEMING: We're not getting into the German patent at all. We have enough problems with the U.S., but — and this is typical when you base a United States patent application on a foreign patent application. You file a copy of the foreign application and, indeed, the United States application, they are actually claiming benefit of the earlier filing of the German patent.

MR. LOGAN: Can we have a side bar on this?

THE COURT: Well, it may be a good time to take a recess for the witness and the witness may take a fifteen-minute recess. The jury may take a fifteen-minute recess. Then I can hear you right here in open court.

Ladies and gentlemen, you may step out.

(Whereupon the jury exited the courtroom at 11:05 a.m.)

THE COURT: Would you tell the witness he may step out for fifteen minutes?

(Whereupon the interpreter instructed the witness that he is excused for 15 minutes.)

MR. LOGAN: If you will recall in the pretrial, Mr. Fleming was talking about the German application and

how different it was from the U.S. application, and we weren't entitled to the priority date. And now he's having the witness refer to the German application to interpret the U.S. application as though they were exactly the same, while he took just the opposite position in our last argument at the pretrial, our final pretrial.

THE COURT: He's not suggesting that they're the same.

MR. FLEMING: No.

MR. LOGAN: If they are different, he shouldn't be referring—

THE COURT: He suggested there's a fundamental difference.

MR. LOGAN: If they are different, he shouldn't be referring to the German text for this purpose.

MR. FLEMING: Judge, there are many differences and that's part of our argument, and I am gathering from Mr. Logan there's no dispute that the plaintiffs are not entitled to the German priority date. I'd like to get that on the record, and that we'll take one step at a time. That is my understanding.

THE COURT: I don't know that he has said that.

MR. LOGAN: No, I have not said that.

THE COURT: If you are entitled to the priority date, what makes this an appropriate, relevant inquiry?

MR. LOGAN: I'd like to know if they're relying on the difference between the dates.

MR. FLEMING: Judge, yes, but look, this is becoming absurd. He's now telling me that he's relying on the German application for a priority date. I am asking the witness to show that they're not entitled to it, it's a different equation, it gives opposite results. I can't think of any more appropriate line of inquiry.

THE COURT: I can't either.

MR. FLEMING: What we're going to get to later —

THE COURT: That is if you're relying upon the priority date.

MR. FLEMING: And even, say, some significance, his thesis popped out in the interim and was published in June.

MR. LOGAN: Well, the thesis was published a month before the U.S. application, so that's not prior art against the U.S. application.

MR. FLEMING: If you're only entitled to the United States findings, then you have a problem.

MR. LOGAN: We don't have a problem on that.

THE COURT: Whether you have a problem with it or not, it's your position as to the priority date, that determines the relevance of the evidence and, you know, if your position is one, then it may not be relevant. If it is something else, then it may be relevant. I don't know what your position is.

MR. LOGAN: We don't have to rely on the German priority date, your Honor.

THE COURT: I don't know what that means. If you tell me you do not rely upon the German priority date, I know what that means. And that is your lead position, that is your leg position.

MR. LOGAN: That is right, your Honor, we don't.

MR. FLEMING: I understand that we now have a stipulation that is on the record, that the patent in suit is not entitled to the German priority date and is entitled only to the date of filing in the United States Patent Office. That is my understanding; is that correct, Counsel?

MR. LOGAN: It's entitled only to the date of filing in United States Patent Office, yes.

MR. FLEMING: And plaintiffs have given up all right to claim the foreign priority date; is that correct?

MR. LOGAN: Yes, your Honor.

MR. FLEMING: Judge, could we just have the reporter explain to Professor Roth that we have just read the last two or three pages of the transcript to bring the jury — for purposes of continuity.

THE COURT: She may so explain.

(Pause.)

(LOUISE MARIE GAEFFKE, resumes as Interpreter for Professor Roth.)

KARLHEINZ ROTH, resumes.

DIRECT EXAMINATION (Continuing)

BY MR. FLEMING:

Q. Now, Professor Roth, would you —

THE WITNESS: We will need Plaintiff's Exhibit 1.

BY MR. FLEMING:

Q. Now, Professor Roth, by referring to your patent, Plaintiff's Exhibit 1, will you tell us specifically what you believe Mr. Thoen would need from the patent to convert his spur to a helical?

A. He needs first the basic rack profile.

Q. Point specifically to the column and the line you are referring to.

A. It is very difficult to say this now in the hurry, but it says in my text it is said in my description that the addendum has to be small and the dedendum big.

Q. How small and how big?

A. This is depending from the number of teeth. To give an example, I have a Figure 1 and 2 for two number of teeth. I have showed these kind of profiles. In Figure 1 I have to look quickly where it is said — I think there is a one-teeth pinion. I have to look it up because it is said here —

Q. Professor Roth, Mr. Thoen in 1961 had designed a four-tooth spur pinion which is shown in these papers; isn't that true?

THE INTERPRETER: 1961?

MR. FLEMING: 1961.

THE WITNESS: Yes, this I have seen.

BY MR. FLEMING:

Q. Now, let's concentrate on a four-tooth pinion. Now, what would you need from your patent to convert this four-tooth spur pinion to helical form?

A. A basic rack profile which you have to use in the normal rack profile for helical gearing, in the normal pro-

file. He has to give a normal profile to produce four-teeth pinion.

I refer always to normal profiles.

Q. Can you point to any specific formula or data in your patent that Mr. Thoen would have to refer to to convert his four-tooth spur to a four-tooth helical?

A. This is, this is not the subject of may patent, to change, to deform, to change a four spur to a helix because I have made these kind of four-teeth pinions in other pieces of work. But you understand what I am mean, I want to tell you why Mr. Thoen with the basic rack profile for a spur gear not was able to make a helix gear.

This model here, that you have put on my table has the profile of Mr. Thoen, if it is the same in the face cut and for this he cannot make a helix gear as it is lying here in front of me.

Q. Professor Roth, you told us last Friday that Mr. Thoen would need information from your patent to convert his spur to a helical and I am now asking you for the benefit of the jury, the Court and myself, to tell us specifically what you were referring to in your patent.

A. He has, he has not to give us the basic rack profile for the face cut but for the normal cut. The whole patent refers only to basic rack profiles in the normal cut.

If you allow me, I'm able to demonstrate this on your beautiful model that everybody can understand.

MR. FLEMING: And the record will show, I'm handing the witness Defendant's Exhibit 17.

THE WITNESS: If you produce a spur gear, you need a hob milling cutter which has this kind of form and so you get back and forth. You turn the wheel and then you receive a spur gear.

So as it is produced in each plant.

If you now want to make a helical gear, so as it is now here, then you will see that this hob milling cutter is not fitting into this form now and the identification of a wheel is also done with the basic rack profile the same

way as you identify a person by name, birthdate and not by his suit as he is at that moment wearing.

If you want to know if it is the wheel or is it not, then w/ have to know which kind of basic rack profile was u ed during production. With this rack profile I cannot do it. With a basic rack profile, I have produced the spur gear. I cannot make the helix. I need another profile.

And if Mr. Thoen says that he has — he could produce this from that, then I say he cannot do it. And the same he was not able to do here, but he could cut it into laminates and then bring them together by a process.

Now I am asking which one is the pinion of Mr. Thoen or that in the normal profile. With this profile which he has here in the spur, he cannot make the helix gear.

MR. FLEMING: For the record, the witness has been referring or has been using a little piece of cardboard to simulate a rack, so I marked that as Defendant's Exhibit 205.

BY MR. FLEMING:

Q. Where in your patent would one find the information to develop this new rack you are talking about?

A. It is said on Figure — column two, line 28, there it is said Figure 1 is the basic rack profile in the normal cut. Figure 2 is the basic rack profile in the normal cut.

Q. Are your referring to Figure 2 in the patent?

A. Yes, Figures 1 and 2 in the American patent.

Q. Don't those show racks for one and two-tooth pinions?

A. Yes. Because they are the most difficult. They are used as an example. But all others you can also apply. I don't know another method to produce helical gears.

MR. FLEMING: Let me have one moment, your Honor.

BY MR. FLEMING:

Q. Can you point to anything else in your patent that you say Mr. Thoen would need?

A. I would need to have his basic rack profile, but I can say what one would have to have. This point I just made is valid for all helical gears. Helix gears, according to the patent, has very small number of teeth. You have to take other measurements.

Q. The question is —

A. Now, I will show you what you need besides.

First, you need basic rack profiles with a small addendum and a large addendum. Number two, you need to — you have to have a large positive deviation, profile deviation, which is not allowed to be either too big or too small. If a profile deviation is too big and you have here values, then the upper part of tooth is just cut away. If it's too small, then you get undercuts. I am not done yet.

The basic rack profile has to be this way, that the contact ratio is big enough. The contact ratios, the profile contact ratios, and this is the most important point, is when there are these small gears, most of the times, too small. And you have to face contact, you have to supplement these face contact ratios so far that they are in one part with the total contact ratio. If you don't go according to the patent, then the tooth either becomes too wide — the angle becomes too big. Both is bad.

Q. Now, I will ask the question hopefully one more time. I asked you to point to specific data in the patent that you say Mr. Thoen would have needed. And you pointed to the rack profiles in Figure 1 and 2.

Now, the question is, can you point to any specific formula number of technical data in the patent that you say Mr. Thoen would need to make the calculations?

A. Yes. In column four, line 64, there it is said the addendum — the addendum has to be 0.6. In the range of size, it can be a little bit bigger, it can be a little smaller.

Q. Is .6 a ratio?

A. It is the head size factor. If you multiply this with the modular, then you get the absolute height.

BOBEL DIRECT — called as a witness by Skil

Q. Now, you have a copy or you have the original patent up there with you. That is Plaintiff's Exhibit 1.

A. This one.

Q. That is in a little different form than you've seen because the front page is the original, has the seal and all that sort of thing.

Now, again, I believe I asked you this, but I just want to refresh everyone's recollection.

When was the first time that you actually read that patent through?

A. Approximately a week and a half to two weeks ago.

Q. And was that in accordance with my request?

A. Yes. You sent it in the mail to me.

Q. And that was for purposes of this lawsuit?

A. Yes.

Q. How much total time do you think you spent reading the patent?

A. Oh, total time, about an hour and a half to two hours. I read it once for about 45 minutes when you sent it to me and I read it on the plane over here.

Q. Do you find anything in the patent that's helpful that as far as designing pinions with small numbers of teeth? That is helpful to you I should say.

A. Not helpful to me no, sir.

Q. Do you find that patent confusing?

A. Very definitely. I read it twice, and after the second time I think I was more confused and bewildered than I was the first time.

To be honest with you, after hearing all the testimony for the last couple of days, I am — I feel very inadequate. I am confused.

Q. Did the testimony help you in any way or hurt you as far as understanding the patent?

A. It didn't help me.

Q. Do you — does the patent describe this supposed invention in clear, concise and exact terms?

A. No, it does not.

Q. Does it describe the manner of making the so-called Roth gears in clear, concise and exact terms?

A. No, it doesn't.

SKIL — Motion for Directed Verdict

MR. FLEMING: Your Honor, we, the defendant moves for a directed verdict on both the invalidity and the non-infringement.

First on the invalidity, we think the evidence shows that the patent fails under Section 112 and Section 103.

First on the 112, I think it ought to be perfectly clear to everyone if there is ever a confusing patent, it's this one. Another thing, Judge, that is absolutely fatal to the validity of this patent, as a matter of law, is this: The patent contains several references to the German standard DIM 58,400 September 1963. It's — that document is unavailable. Plaintiffs, notwithstanding our repeated request, have been unable to produce it.

Now, when Professor Roth testified, and I refer to Volume 4, pages — or page 16, that is 4.116, he testified that it was necessary to have that standard to design a gear. Judge, we are entitled to a directed verdict of non-validity in this case at that point at all — alone. Cannot satisfy the requirements of Section 112 which require not only that the purported invention, but the manner and method of making it be pointed out in clear, concise and exact terms.

And when you refer to an unavailable foreign publication and when you have the testimony of a party to the suit who happens to be the inventor, which says it is necessary, Judge, this case is going to be over on that point. In fact, maybe I should just stop there and let them respond to that before I go to anything else.

THE COURT: No, why don't you make your whole argument.

MR. FLEMING: All right. Now, the other point is the obviousness. There's clearly no presumption of validity in this case. Mr. Thoen went through the five ref-

erences the examiner cited. It's perfectly clear they're all out in left field.

The United States Examiner didn't come close to finding prior art dealing with these pinions of low numbers of teeth and really after much arduous cross-examination of the witnesses, I think the record finally shows, not only from, of course, our own witness, Mr. Thoen, but from the plaintiff's witnesses, that all the technology that you needed to do these gears is right there in these publications.

The only thing they're trying to hang their hat on are these so-called warnings and admonitions, but that is an unrealistic way to approach it. And moreover, we have evidence in the record, of course, that these warnings were disregarded. Mr. Kaman testified that even back in his days at Thor, they had five-tooth helical involutes.

So, they're hanging that on that lower number.

MR. FERRILL: Your Honor, may I inform the Court of one point that my colleague just pointed out to me, sir? The German standard No. 58,400 should someone in the United States want to make reference to the German standard in connection with this sentence where it says, according to the invention it's preferred to use as the basic profile for the wheel the standard profile for precision work as laid down by German Industrial Standard No. 58,400 (draft of September 1963) which your Honor will note is the date of the — is the time this case was being filed and Mr. Logan points out to me that we have the German — the versions of this German Industrial standard for precision work as laid down for No. 58,400 in three of its motions before and after this date, not happening to have that particular one issue of it. We have the '61 — we have the '61, '62 and '65.

MR. LOGAN: Yes.

MR. FERRILL: '61, '62 and '65. I submit, your Honor, that it was somewhat of a — that our opponent is straining we submit to make —

THE COURT: I thought I made this before.

MR. FLEMING: Judge, their own witness said it was necessary to have this particular draft.

THE COURT: You know, I thought we talked about this before in a pretrial conference, but I also assumed that, you know, that certainly if there's a standard which exists, that if it hasn't been produced up to now, it will be produced by the time of trial.

MR. FLEMING: That's exactly —

THE COURT: And that this is just going to float away. And I really never thought of any importance.

MR. FLEMING: That's exactly what I thought. I had my Rule 34. I even had it for a list of the exhibits, to see if it was going to appear. Of course, they didn't list it as an exhibit. They couldn't produce it.

I did bring that up at the time, several months ago. They had a real problem —

THE COURT: So it isn't that it is a new item to me. You know, I had a feeling that I had before. I think, you know, practically I think Rule 50(b) suggests that you go and submit it to the jury and let the jury determine it. I know that that may appear to be inappropriate to defense counsel, but you preserve your legal arguments and after this long, perhaps the jury will —

MR. FLEMING: Judge, it's a waste of everyone's time, if that patent is invalid as a matter of law, and it will be inconvenient and expensive for my client, but I'm not worried about reversal on this one.

THE COURT: If it becomes clear to me as a matter of law that you're entitled to a directed verdict, even though I think that the most convenient thing to do is to submit it to the jury, I will give you your verdict as a matter of law.

If I have doubts as to the law —

MR. FLEMING: Sure.

THE COURT: — I'm going to submit it to the jury because there's no reason —

MR. FLEMING: I agree.

THE COURT: —to do — there's no reason to waste all these days of testimony.

MR. FLEMING: I agree.

THE COURT: And not submit it to the jury in that case.

But if it becomes clear to me —

MR. FLEMING: That's right.

THE COURT: — that as a matter of law there is no possible way in which this problem can be cured, obviously, while I might be wrong on the law, I think I — to a party to moves for a directed verdict to rule on a motion of a directed verdict, if it is not clear, and I need additional time for briefing and so forth, I probably would submit it to the jury, knowing under 50(b) that you still preserve your question of law. And it is purely a question of law.

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SKIL — Summation to Jury on Interrogatory 11.

The next special verdict is number 11, which gets into this question now of the sufficiency of the patent. How well it describes what this invention is supposed to be. Now, in that regard, ladies and gentlemen, I imagine a lot of you are wondering at this time, what is this invention? Have these people really tried to use the patent and tried to explain something to you in understandable language? I don't think they have. They keep talking terms of results, efficiency. Everyone knows it's efficiency to go to helical gearing. That's a well known phenomenon.

* * *

And another thing, ladies and gentlemen, I remember distinctly when this case started off. I remember all kinds of testimony about this, that and the other thing. Nothing about the patent. Normally in a patent case, the plaintiff is proud of the patent. He'll start right off, put a witness on the stand, start going through it in chaper and verse to explain to you what it's supposed to be about. Not in this case. They tried to avoid the patent. Even in their infringement determinations, what are they used for in infringement determinations? A 12-page document, 26 steps that aren't shown in the patent. When it comes time to proving infringement, they don't use the patent. They use some document that makes reference to all kinds of steps and measurements beyond the patent.

Now, the first special verdict that you're going to be asked to do is whether the patent contains a written description of the alleged invention. You're going to be instructed by the Court that the patent has to do two things: It has to describe the alleged invention and the manner of making and using it in full, clear, concise and exact terms. Those — that's what the patent laws say.

In this patent, with mistakes in formulas in claims, that inequality expression with this other formula that we had so much testimony about in column four of the

patent, about line 72, this H_k and all this business. Think of the inconsistencies and the errors in the patent. Think of Mr. Bobel's testimony.

Now, here's a man who's supposed to get some benefit out of this patent. He's an ordinary guy out there, employed by a power tool company to design gears. Of course, the evidence shows that he didn't even see the patent about a week and a half before trial, when I asked him to read it for the first time. He testified to that. That testimony stands absolutely unchallenged. He said the patent wouldn't have helped him at all, as I remember. It confused him and the more people he heard up on the stand, it still confused him. So does a patent like that satisfy the requirements for full, clear, concise terms?

And as the patent makes reference to some 1963 German publication that Professor Roth says was necessary to make his gears. That hasn't been produced in the record. So how can a patent point out everything in full, concise terms when you have to refer to some German patent that the plaintiffs haven't produced?

Now, again, you've got conflicting testimony. You notice Bobel. He's the guy out there who was supposed to be able to design power tools, like my company, my client, and he said, they're the ones that set him back. He didn't say that, but words to that effect, and you'll remember the gist of what he said.

On the other hand, you have Mr. Thoen who pointed out errors in the patent and you remember Mr. Drago and Mr. Berlinger, and that's the decision you're going to have to make, ladies and gentlemen. We know that you're not going to go back into the juryroom and get your pocket calculators and go through that formula and we know you can't do that. You've got to decide those questions. You've got to think who are the witnesses up there that were really trying to help you and really trying to put the evidence before you who are answering questions in a forthright manner.

For example, Mr. Thoen who went up there and literally derived the formula. Remember his three circles going from here to Chicago? You have to compare that on the one hand, and you've got to compare plaintiffs on tne other hand of changing exhibits. They give us exhibits before trial that are supposed to explain how you can compute infringement. Mr. Berlinger gets up there on the witness stand and has a new document for the first time. It has changes in it, which is now marked as Plaintiff's Exhibit 200. Those are the things that you've got to consider and to determine who do you think — whose witnesses were up there trying to help you determine whether that equation had anything — was wrong or incorrect.

So our special verdicts 11 and 12 go to those two issues.

From the Court's instructions to the Jury.

Now, we have certain interrogatories here which relate to specifications and claims. And if you will look at Interrogatories 11 and — 11 first, does the specification of the Roth patent, that is, the portion of the patent in Columns 1, 2, 3 and 4 and the first four lines of Column 5, contain a written description, including its drawings and text, of the alleged invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected to make and use the same. You've heard a lot of evidence in this case, and once again I will not repeat it or make reference to who called the various witness, but there has been lot — a lot of evidence as to this particular issue and it's for your determination.

Now, 12, does the specification of the Roth patent, that is, the portion of the patent in Columns 1, 2, 3, 4 and the first four lines of Column 5, contain a written description including its drawing and test, of the manner and process for making and using the alleged invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with

which it most — or with which it is most nearly connected, to make and use the same. And there again, in Number 11, we asked whether — about whether it is clear, whether the invention is. In 12 we ask about making and using the alleged invention. And there have, of course, been evidence to you — submitted to you in regard to that.

DX-29

Rechtsanwalt Bernhard Seidler
Widenmayerstrasse 50
8 Munchen 22, Germany

Re: Improvements in Involute Gear Combinations
U. S. Serial No. 330 130
(Corres. to German Serial No. S 83 289 XII/47h)
Your Ref.: 4920 S/P
Our Ref: Seidler Case 8

Dear Sir:

In reply to your letter dated June 22, 1965, we have amended the application in accordance with your instructions. We are enclosing copies of our response, together with our debit note for the preparation thereof.

In connection with the reference to the German Industrial Standards appearing in the specification and Claim 5, assuming that these Standards are available to the public in printed form, we see no reason why it would be necessary to replace them in the specification by a reference to a corresponding United States Industrial Standard or by a more complete structural description. With respect to the use of this terminology in Claim 5, the situation is not quite so clear, but in our opinion, we believe the claim should be allowed to remain in its original form. We must point out that the use of this type of terminology in a *claim* is quite irregular by U. S. claim writing standards, and we are somewhat surprised that the Examiner did not object thereto. However, it is also true that some U. S. Examiners will allow considerable latitude in claiming an invention providing that the way in which the invention is claimed is not clearly contrary to established procedures. We believe that the Examiner could find no concrete reason for objecting to Claim 5 and, thus, he is prepared to allow it in its present form.

While we would have preferred to write a more exact description of the structure involved, in view of the fact that the claim has been allowed and the Examiner has closed out prosecution on merits and, further, in view of the fact that Claim 5 is a dependent claim, we would suggest that this claim be allowed to remain as it presently is. We would suggest, however, that in any future cases where a similar situation is present that a more complete structural definition of the invention be given, particularly in the claims. We think that the present application involves a unique situation in which the Examiner has gone much farther than is customary in allowing us to claim the invention in this fashion, and we think that it would be highly doubtful that this would be repeated in another case.

Yours very truly,

L. Martin Flynn

LMF/6

Enc: Response (2)
Debit Note (2)

Airmail

35 U.S.C. §112

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

A claim may be written in independent or, if the nature of the case admits, in dependent or multiple dependent form.

Subject to the following paragraph, a claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.

A claim in multiple dependent form shall contain a reference, in the alternative only, to more than one claim previously set forth and then specify a further limitation of the subject matter claimed. A multiple dependent claim shall not serve as a basis for any other multiple dependent claim. A multiple dependent claim shall be construed to incorporate by reference all the limitations of the particular claim in relation to which it is being considered.

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

35 U.S.C. §282

A patent shall be presumed valid. Each claim of a patent (whether in independent, dependent, or multiple dependent form) shall be presumed valid independently of the validity of other claims; dependent or multiple dependent claims shall be presumed valid even though dependent upon an invalid claim. The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.

The following shall be defenses in any action involving the validity or infringement of a patent and shall be pleaded:

(1) Noninfringement, absence of liability for infringement or unenforceability,

(2) Invalidity of the patent or any claim in suit on any ground specified in part II of this title as a condition for patentability,

(3) Invalidity of the patent or any claim in suit for failure to comply with any requirement of sections 112 or 251 of this title,

(4) Any other fact or act made a defense by this title.

In actions involving the validity or infringement of a patent the party asserting invalidity or noninfringement shall give notice in the pleadings or otherwise in writing to the adverse party at least thirty days before the trial, of the country, number, date, and name of the patentee of any patent, the title, date, and page numbers of any publication to be relied upon as anticipation of the patent in suit or, except in actions in the United States Claims Court, as showing the state of the art, and the name and address of any person who may be relied upon as the prior inventor or as having prior knowledge of or as having previously used or offered for sale the invention of the patent in suit. In the absence of such notice proof of the

said matters may not be made at the trial except on such terms as the court requires.

608.01(p) Completeness

Newly filed applications obviously failing to disclose an invention with the clarity required are discussed in §702.01.

A disclosure in an application, to be complete, must contain such description and details as to enable any person skilled in the art or science to which the invention pertains to make and use the invention as of its filing date, *In re Glass*, 181 USPQ 31; 492 F.2d 1228 (CCPA 1974).

While the prior art setting may be mentioned in general terms, the essential novelty, the essence of the invention, must be described in such details, including proportions and techniques where necessary, as to enable those persons skilled in the art to make and utilize the invention.

Specific operative embodiments or examples of the invention must be set forth. Examples and description should be of sufficient scope as to justify the scope of the claims. Markush claims must be provided with support in the disclosure for each member of the Markush group. Where the constitution and formula of a chemical compound is stated only as a probability or speculation, the disclosure is not sufficient to support claims identifying the compound by such composition or formula.

A complete disclosure should include a statement of utility. This usually presents no problem in mechanical cases. In chemical cases, varying degrees of specificity are required.

A disclosure involving a new chemical compound or composition must teach persons skilled in the art how to make the compound or composition. Incomplete teachings may not be completed by reference to subsequently filed applications.

702 Requisites of the Application

When a new application is assigned in the examining group the examiner should review the contents of the application to determine if the application meets the requirements of 35 U.S.C. 111. Any matters affecting the filing date of the application, such as lack of an oath or declaration, filing fee, or claims should be checked before the application is placed in the storage racks to await the first action.

The examiner should be careful to see that the application meets all the requisites set forth in chapter 600 both as to formal matters and as to the completeness and clarity of the disclosure. If all of the requisites are not met, applicant may be called upon for necessary amendments. Such amendments, however, must not include new matter.

RULE 49 (a) F.R.C.P.

Rule 49. Special Verdicts and Interrogatories

(a) SPECIAL VERDICTS. The court may require a jury to return only a special verdict in the form of a special written finding upon each issue of fact. In that event the court may submit to the jury written questions susceptible of categorical or other brief answer or may submit written forms of the several special findings which might properly be made under the pleadings and evidence; or it may use such other method of submitting the issues and requiring the written findings thereon as it deems most appropriate. The court shall give to the jury such explanation and instruction concerning the matter thus submitted as may be necessary to enable the jury to make its findings upon each issue. If in so doing the court omits any issue of fact raised by the pleadings or by the evidence, each party waives his right to a trial by jury of the issue so omitted unless before the jury retires he demands its submission to the jury. As to an issue omit-

ted without such demand the court may make a finding; or, if it fails to do so, it shall be deemed to have made a finding in accord with the judgment on the special verdict.

RULE 50(b) F.R.C.P.

Rule 50. Motion for a Directed Verdict and for Judgment Notwithstanding the Verdict

(b) MOTION FOR JUDGMENT NOTWITHSTANDING THE VERDICT. Whenever a motion for a directed verdict made at the close of all the evidence is denied or for any reason is not granted, the court is deemed to have submitted the action to the jury subject to a later determination of the . . .

(following text cut off on p.53 of F.R.C.P. xerox)

The Constitution of the United States, Article 1, Section 8, Clause 8

The Congress shall have the power to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

The Constitution of the United States, Amendment VII — Civil Trials

In Suits at common law, where the value in controversy shall exceed twenty dollars, the right of trial by jury shall be preserved, and no fact tried by a jury, shall be otherwise reexamined in any Court of the United States, than according to the rules of the common law.

84-1568

FILED
APR 2 1985
ALEXANDER L. STEVAS
CLERK

No.

IN THE

SUPREME COURT OF THE UNITED STATES

October Term, 1984

QUAKER CITY GEAR WORKS, INC., *et al.*,
Petitioners

v.

SKIL CORPORATION,
Respondent

APPENDIX B TO PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

Thomas M. Ferrill, Jr.
John W. Logan, Jr.
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INVOLUTE GEAR COMBINATIONS
Filed Dec. 12, 1963 5 Sheets-Sheet 1

Fig. 1

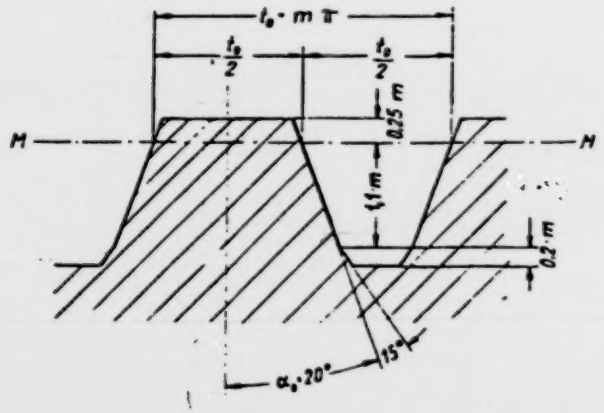
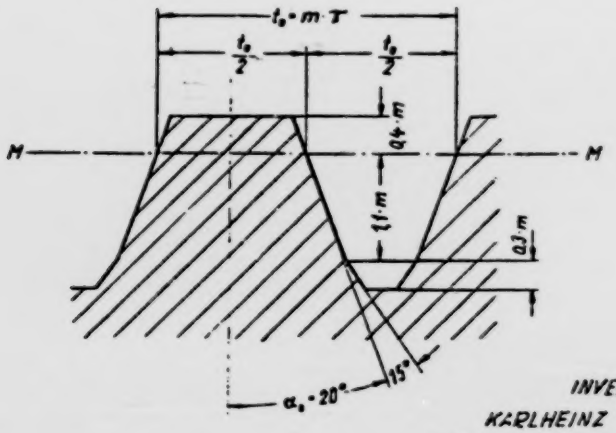


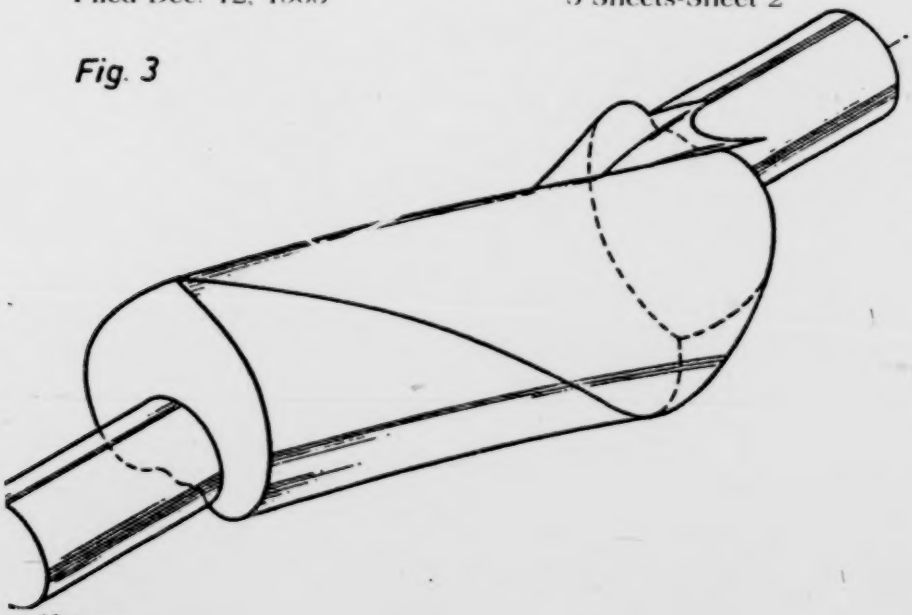
Fig. 2



INVENTOR
KARLHEINZ ROTH
BY
Williams, Blanchard & Flynn
ATTORNEYS

April 26, 1966 K. ROTH 3,247,736
INVOLUTE GEAR COMBINATIONS
Filed Dec. 12, 1963 5 Sheets-Sheet 2

Fig. 3



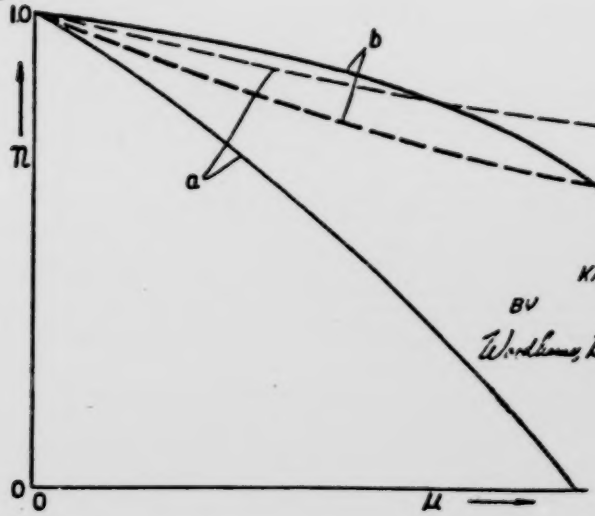


Fig. 8

INVENTOR
KARLHEINZ ROTH
BY
Wenderoth, Blanchard & Flynn
ATTORNEYS

April 26, 1966 K. ROTH 3,247,736
INVOLUTE GEAR COMBINATIONS
Filed Dec. 12, 1963 5 Sheets-Sheet 3

Fig. 4

INVENTOR
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April 26, 1966 K. ROTH 3,247,736
INVOLUTE GEAR COMBINATIONS
Filed Dec. 12, 1963 5 Sheets-Sheet 4

Fig. 5

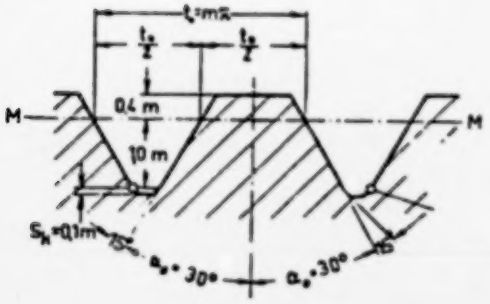

Fig. 6

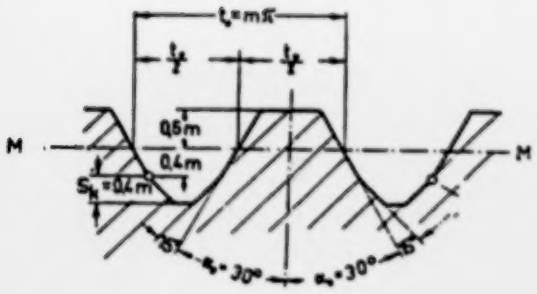

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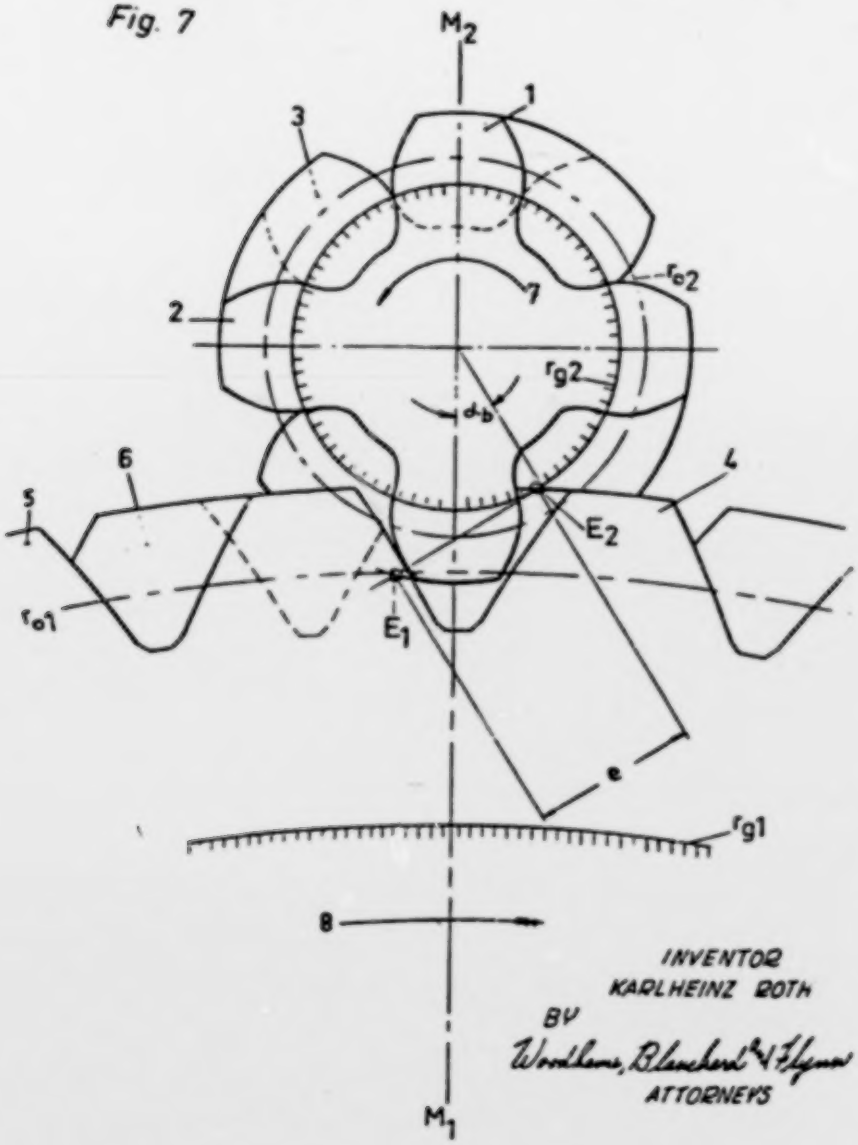
Fig. 7



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INVOLUTE GEAR COMBINATIONS

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Filed Dec. 12, 1963, Ser. No. 330,130
Claims priority, application Germany, Jan. 17, 1963, S 83,289
5 Claims. (Cl. 74—462)

The invention relates to a combination of involute gears wherein the pinion has a small number of teeth, as hereinafter defined.

In precision work it is particularly desirable to use gears having only a small number of teeth. The cost of making a gear of given dimensions and given quality depends on the number of teeth; the smaller the number of teeth, the lower is the cost of production. If the number of teeth on the pinion is reduced then, for a constant gear ratio, the number of teeth on the wheel is reduced to the same extent. Thus, if only two teeth are used for the pinion instead of eight, the number of teeth on the wheel is also reduced by the factor 4. The centre distance, the pitch circles and thus the addendum circles and the cross-section of the gear casing are reduced to the same extent. Further, a low number of teeth is desirable for a gear combination which is required to achieve a high step-down or step-up ratio in the fewest possible stages. Especially for this purpose a reduction in the number of teeth for the pinion leads to a further reduction in the overall size of the stage.

The invention relates to a combination of involute gears wherein the virtual number of teeth on the pinion is no more than five. The virtual number of teeth z_v, also known as the normal number of teeth, is defined by the equation

$$z_v = z/\cos^2 \beta_g \cdot \cos \beta_0$$

where z is the number of teeth in normal section, β_g is the helix angle on the base cylinder and β_0 is the helix angle on the pitch cylinder. In the gearing art, involute gears are preferred because they can be made with straight-sided cutters and any variation in the centre distance of the gears does not alter the momentary gear ratio as it would, for example, in cycloidal and spiral gear combinations. In worm gear and helical gear combinations, the axes intersect. Such gearing is therefore unsuitable where parallel axes are desired, for example in plate constructions. Even if intersecting axes bring about no structural disadvantages, the transmission efficiency of such gearing, for example worm gears, is generally lower than the efficiency of involute gears. A further disadvantage of worm gears is that step-up transmission is often impossible.

The invention aims to provide involute gearing with parallel gear axes, wherein the number of teeth on the pinion is so small that gear ratios are obtainable in one stage equal to those possible with worm gearing and without the overall size of the involute gears being much greater than that with worm gears. The gear combination according to the invention is suitable for pinion teeth in which the number z_v is equal to or less than 5 and the gear combination comprises the following features:

(a) Both gears helical, the helix angle being defined by

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_0 < 1.5$$

wherein β_0 = helix angle at pitch cylinder,

m_n = module

b = minimum width of tooth and z_v = virtual number of teeth;

(b) The pinion has a small addendum and a large effective dedendum if it is the driver or a large addendum and small useful dedendum if driven, the profiles of the gear combination being complementary in respect of the tooth sides involved in power transmission;

(c) There is a profile deviation which is positive for the pinion in a step-down combination but negative in a step-up combination and positive for the wheel in a step-up combination.

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As a result of an adequate profile engagement factor obtained by means of the invention, the required helix angle β_0 is much smaller than hitherto.

The reduction in the addendum or dedendum, as the case may be, and the profile deviation, may be adapted to one another so that the greater part of the line of action (relatively to the centre line and to the driver) lies on the side adjacent the point of final engagement. The pressure angle (half the angle of the sides of the basic rack profile) is preferably from 15° to 25° for a step-down combination and from 25° to 35° for a step-up combination. Further, in a step-down involute gear combination according to the invention it is preferred to use as the basic profile for the wheel the standard profile for precision work as laid down by German Industrial Standard No. 58400 (draft September 1963).

Three examples of the invention are illustrated in the accompanying drawing, wherein:

FIG. 1 is the basic rack profile in normal section for a pinion having a single tooth;

FIG. 2 is the basic rack profile in normal section for a pinion having two teeth;

FIG. 3 is a perspective view of a pinion having a single tooth;

FIG. 4 is a perspective view of the pinion having two teeth;

FIGS. 5 and 6 illustrate the two complementary basic profiles for a step-up combination;

FIG. 7 illustrates a step-up combination, and

FIG. 8 is a graph showing the basic course of the efficiency of the step-up gearing according to FIG. 7.

In the profile according to FIG. 1, the module m is, as usual, taken as the reference parameter. All the measurements except the angles will be in millimetres when multipled by the module. The chain dotted line M—M is located so that the tooth thickness is equal to the tooth gap and equal to half the pitch t_0. The pitch t_0 amounts to 3.14159 modules. The addendum is 0.25 module, the dedendum 1.1 module and the bottom clearance 0.2 module.

A helical gear made with these dimensions by a hob milling process is illustrated in FIG. 3. The face width amounts to about 6 modules; the helix angle at the pitch cylinder $\beta_0 = 15.2°$. By using the helical tooth form, a transverse contact ratio larger than 1 is obtainable for the gear combination as a whole even though the transverse contact ratio in any one lamina plane of the combination is less than 1. The minimum helix angle necessary for engagement is limited by the formula

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_0 < 1.5$$

In order to keep the axial forces on the gears to a minimum, a small helix angle is desirable. In addition, a small helix angle has a favourable effect on the form of the sides of the gears if they are made with a hob milling machine. The spread, i.e. the arc of the pitch circle between the two pitch cylinder lines through the points of intersection between a line passing through a side of the tooth and the two normal faces of the gearing, is chosen so that the transverse contact ratio ε of the combination is larger than 1. The mating profile can

be a standard profile, preferably according to German Industrial Standard 58400 draft September 1963 for the precision industry. For the case where the pinion has one tooth ($z=1$), the spread is half the pitch ($t_0/2$), the wheel has 30 teeth and the helix angle β_0 is 15.2°, the transverse contact ratio ϵ will be equal to or larger than 1.1.

The standard profile for the procision industry according to German Industrial Standard No. 58400 is complementary to the basic profile of FIG. 1 in respect of the sides of the teeth involved in power transmission, i.e. the pinion of FIGS. 1 or 3 has a small addendum and a large dedendum, whilst the mating wheel has a large addendum and a small dedendum as far as the portions involved in power transmission are concerned. Thus, in the case of the standard profile according to German Industrial Standard 58400 draft September 1963, a portion of the dedendum available for power transmission is not used in the gear combination in question. This unutilised portion can, however, be utilised in co-operation with another gear. Naturally, it is also possible to provide a basic profile which has a small dedendum to begin with. Such a gear has the advantage of being somewhat stronger but the disadvantage of being useful only in combination with the pinion of FIGS. 1 or 3.

The basic profile of FIG. 2 has, in relation to that of FIG. 1, a somewhat larger addendum, namely 0.4 module, and a somewhat larger bottom clearance of 0.3 module. The mating pinion (FIG. 4) likewise has a face advance of half the pitch ($t_0/2$). The minimum face width is obtained by the formula

$$-0.35z_v+1.4<\frac{b}{m_n}\sin\beta_0<1.5$$

The helix angle is 15.2°. The pinion of FIG. 4 can likewise be combined with a helical gear made according to German Industrial Standard 58400 draft September 1963. The basic profile of FIG. 2 is also complementary to the profile of German Standard 58400 draft September 1963. Further, it is possible, although less advantageous to use a mating helical gear according to German Industrial Standard No. 867.

FIG. 5 shows the basic profile for a gear in a step-up combination. m represents the module, to t_0 the pitch, $\alpha_0=30°$ half the angle of the side, $S_K=0.1\ m$ the bottom clearance. The reference line M—M represented by a chain dotted line is located so that the tooth thickness and tooth gap are equal. The point P designates the end of the useful tooth surface of the basic rack profile. FIG. 6 illustrates a basic profile complementary to the basic profile of FIG. 5 and the same references are used as in FIG. 5.

A gear combination consisting of helical gears corresponding to the basic profiles of FIGS. 5 and 6 is illustrated in FIG. 7. The pinion 1 has four teeth and the wheel 4 has forty teeth. The drawing shows the front faces 2 and the rear faces 3 for the pinion 1 and the front faces 5 and rear faces 6 for the wheel 4. The transverse contact ratio for a laminate amounts to about 0.7 and when considering the face contact ratio the total engagement factor is 1.2. The direction of rotation of the gears 1 and 4 is represented by the arrows 7 and 8, respectively; thus, the illustrated version is a step-up gearing. The line of action E1, E2 is located principally on the righthand side of the line M1, M2, i.e. on the side adjacent the point of final engagement. Upon commencement of engagement (pushing friction) the sides of the teeth slide on one another only to a small extent because the point E1 lies close to the centre line M1, M2, whereas upon termination of engagement (pulling friction) at the point E2 the more intensive sliding of the tooth sides upon one another is less detrimental. FIG. 8 is a graphical representation of the momentary efficiency relatively to the coefficient of friction μ for a conventional gear combination (a) and for a laminate

of the gear combination according to the invention (b). Although the number of teeth in the combination according to the invention is less, the efficiency is higher.

The curves for commencement of engagement are shown in full lines whilst the curves for termination of engagement are shown in broken lines. As evident from FIG. 8, the curves for the gear combination according to FIG. 7 lie closer to one another than the corresponding curves for conventional gear combinations. In particular, the drop in efficiency η upon an increase in friction μ is not so great upon commencement of engagement and always lies considerably above zero. The principal advantage of this is that jamming of the gears upon commencement of engagement is avoided with the construction according to the invention even with a coefficient of friction $\mu=1.0$. Accordingly, the gear combination according to the invention is particularly suitable for difficult operating conditions in which the coefficient of friction may become particularly high as a result of infrequent servicing and/or the presence of sand or dust in the atmosphere. The graphs for a lamina normal section also apply in this case.

The general limitations for the helix angle β_0 have been mentioned previously. In a step-down combination

$$-0.35z_v+1.4<\frac{b}{m_n}\sin\beta_0<-0.4z_v+2,$$

whereas in a step-up combination

$$0.6<\frac{b}{m_n}\sin\beta_0<1.5$$

For the profile deviation x of the pinion

$$0<x<-0.35z_v+2.5$$

in a step-down combination and

$$x<0$$

in a step-up combination and in general

$$-0.125z_v+0.2<x<-0.35z_v+2.5$$

The following are practical values for the profile deviation.

Step-down gearing:

- Five teeth on pinion, $x=+0.7$
- Four teeth on pinion, $x=+0.88$
- Three teeth on pinion, $x=+0.92$
- Two teeth on pinion, $x=+0.98$
- One tooth on pinion, $x=+1.03$

Step-up gearing:

- Three teeth on pinion, $x=-0.2$ and thus $x=+0.3$ for the wheel
- Four teeth on pinion, $x=-0.15$ and thus $x=+0.5$ for the wheel
- Five teeth on pinion, $x=-0.22$ and thus $x=+0.5$ for the wheel

The following values are examples for the addendum and dedendum in step-down gear combinations.

Addendum for the driver, useful dedendum for the driven:

One tooth on pinion	0.25
Two teeth on pinion	0.4
Three teeth on pinion	0.5
Four teeth on pinion	0.6
Five teeth on pinion	0.7

The addendum of the driven gear and the corresponding dedendum of the driving gear may be 1.1 in this case.

For step-down gear combinations the driving gear may have an addendum of 0.4 and a dedendum of 1.0, without any modifications.

The addendum as referred to above is given by

$$h_k=\tfrac{1}{2}[d_k-(z+2x)m]$$

wherein d_k=diameter of addendum circle, z=number of teeth, x=profile deviation factor and m=module.

The profile deviation xm is the displacement of the reference line of the cutting tool from the pitch circle of the wheel. The reference line of the cutting tool is located where the tooth thickness is equal to the tooth gap.

What I claim is:

1. A combination of involute gears in which the shafts of the two gears are parallel to one another and wherein the virtual number of teeth on the pinion is no more than five, comprising the following features:

(a) Both gears are helical and the helix angle is given by

$$-0.35z_v+1.4<\frac{b}{m_n}\sin\beta_0<1.5$$

wherein β_0=helix angle at the pitch cylinder, m_n=module, b=minimum tooth width and z_v=virtual number of teeth;

(b) the pinion has a small addendum and a large useful dedendum (difference between useful height of tooth and addendum) if it is the driver, or a large addendum and a small useful dedendum if it is the driven, the profiles of the combination being complementary in respect of the tooth sides involved in power transmission;

(c) there is a profile deviation which is positive for the pinion in a step-down combination but negative in a step-up combination, and positive for the wheel in a step-up combination.

2. A combination according to claim 1 wherein the reduction in the addendum or dedendum, as the case may be, and the profile deviation are adapted to one another so that the greater part of the line of action (relatively to the centre line and relatively to the driver) lies on the side adjacent final engagement.

3. A step-down gear combination according to claim 1 wherein the pressure angle (half the angle of the sides of the basic rack profile) is between 15° and 25°.

4. A step-up gear combination according to claim 1 in which the pressure angle is between 25° and 35°.

5. A step-down gear combination according to claim 1 wherein the basic profile of the wheel is the standard profile for the precision industry according to German Industrial Standard No. 58400 draft September 1963.

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DON A. WAITE, *Primary Examiner.*

TRANSLATION OF GERMAN APPLICATION
filed January 17, 1963
copied from
DX 26, Appendix Vol. IV, pp. 1703-09

Involute gear mating with a small number of teeth on the smaller gear

It is especially desirable for precision engineering to get along with small numbers of teeth on the gears. The production costs of a gear of given dimensions and given quality depend on the number of the individual teeth; the smaller the number of teeth, the lower the cost of the individual gear will be. If one decreases the number of the teeth on the smaller gear (pinion gear), then the number of teeth on the bigger gear is reduced to the same degree while maintaining the same gear ratio; thus, if instead of eight only two teeth are used for the pinion gear, then the number of teeth on the bigger gear is reduced by the factor of 4. A reduction in the number of teeth is, moreover, desirable in the case of a mating that is to provide a big step-down or step-up. Above all, for this type of application the reduction in the number of teeth on the smaller gear leads to a further reduction in the overall structural size of the stage.

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1
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INVOLUTE GEAR COMBINATIONS

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Filed Dec. 12, 1963, Ser. No. 330,130
Claims priority, application Germany, Jan. 17, 1963, S 83,289
5 Claims. (Cl. 74—462)

The invention relates to a combination of involute gears wherein the pinion has a small number of teeth, as hereinafter defined.

In precision work it is particularly desirable to use gears having only a small number of teeth. The cost of making a gear of given dimensions and given quality depends on the number of teeth; the smaller the number of teeth, the lower is the cost of production. If the number of teeth on the pinion is reduced then, for a constant gear ratio, the number of teeth on the wheel is reduced to the same extent. Thus, if only two teeth are used for the pinion instead of eight, the number of teeth on the wheel is also reduced by the factor 4. The centre distance, the pitch circles and thus the addendum circles and the cross-section of the gear casing are reduced to the same extent. Further, a low number of teeth is desirable for a gear combination which is required to achieve a high step-down or step-up ratio in the fewest possible stages. Especially for this purpose a reduction in the number of teeth for the pinion leads to a further reduction in the overall size of the stage.

Translation of
German Application

The invention concerns an involute gear mating with a pinion gear tooth number $Z1 \leq 5$. =

As is known, involute gears are preferred in transmission technology because they can be produced with straight-flanked tools and a change in the axial distance of the gears does not change the instantaneous transmission ratio, as is the case, e.g., with cycloidal and circular arc gear mating. As is known, the axes intersect in worm gear and helical gear mating. These gear systems are therefore not suitable for gearing designs with parallel axes, e.g., for those executed in Platinenbauweise. The transmission efficiency of a worm gear mating is usually worse than the efficiency of an involute gear mating; a further disadvantage of the worm gear transmission is that a step-up is not possible. It is the problem of the invention to create an involute gear mating for parallel axes of the gears in which the number of teeth on the smaller gear (pinion) is so small that with the involute gearing matings according to the invention, transmissions can be realized in one stage which equal the possible transmissions of a worm drive without the strucutral size of the involute gear mating according to the invention fundamentally exceeding that of the worm drive. The gear mating of the invention is suitable for pinion gear tooth numbers under 5 and is characterized by the following features: =

U. S. Patent

The invention relates to a combination of involute gears wherein the virtual number of teeth on the pinion is no more than five. The virtual number of teeth z_v, also known as the normal number of teeth, is defined by the equation

$$z_v = z/\cos^2 \beta_g \cdot \cos \beta_0$$

Added Disclosure

where z is the number of teeth in normal section, β_g is the helix angle on the base cylinder and β_0 is the helix angle on the pitch cylinder. In the gearing art, involute gears are preferred because they can be made with straight-sided cutters and any variation in the centre distance of the gears does not alter the momentary gear ratio as it would, for example, in cycloidal and spiral gear combinations. In worm gear and helical gear combinations, the axes intersect. Such gearing is therefore unsuitable where parallel axes are desired, for example in plate constructions. Even if intersecting axes bring about no structural disadvantages, the transmission efficiency of such gearing, for example worm gears, is generally lower than the efficiency of involute gears. A further disadvantage of worm gears is that step-up transmission is often impossible.

The invention aims to provide involute gearing with parallel gear axes, wherein the number of teeth on the pinion is so small that gear ratios are obtainable in one stage equal to those possible with worm gearing and without the overall size of the involute gears being much greater than that with worm gears. The gear combination according to the invention is suitable for pinion teeth in which the number z_v is equal to or less than 5 and the gear combination comprises the following features:

Translation of
German Application

a) Such profiles are used for the smaller gear as have for the drive gear a small crown of tooth height and a big useful root of tooth depth, for the driven gear a big crown of tooth height and small useful root of tooth depth; the profiles of the tooth mating behave complementarily to each other with reference to the flank involved in the power transmission. =

b) A profile displacement is made such that for a gear mating for stepping down a rotary motion the smaller gear (pinion) has a positive profile displacement, for a gear mating for stepping up, on the other hand, the smaller gear (pinion) has a negative profile displacement. =

c) Crown shortening or root of tooth decrease and profile displacement are so adjusted to each other that the length of contact (with reference to the center line and with reference to the driving gear) for the most part lies on the side of the contact end. =

d) The contact angle α_0 is selected for a gear mating for stepping down of 15° to 25°, while for a gear mating for stepping up a contact angle of 25° to 35° is selected. =

U. S. Patent

(a) Both gears helical, the helix angle being defined by

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_o < 1.5$$

wherein β_o = helix angle at pitch cylinder,

m_n = module

b = minimum width of tooth and z_v = virtual number of teeth;

Additional Disclosure

(b) The pinion has a small addendum and a large effective dedendum if it is the driver or a large addendum and small useful dedendum if driven, the profiles of the gear combination being complementary in respect of the tooth sides involved in power transmission;

(c) There is a profile deviation which is positive for the pinion in a step-down combination but negative in a step-up combination and positive for the wheel in a step-up combination.

As a result of an adequate profile engagement factor obtained by means of the invention, the required helix angle β_o is much smaller than hitherto.

New

The reduction in the addendum or dedendum, as the case may be, and the profile deviation, may be adapted to one another so that the greater part of the line of action (relatively to the centre line and to the driver) lies on the side adjacent the point of final engagement. The pressure angle (half the angle of the sides of the basic rack profile) is preferably from 15° to 25° for a step-down combination and from 25° to 35° for a step-up combination. Further, in a step-down involute gear combination according to the invention it is preferred to use as the basic profile for the wheel the standard profile for precision work as laid down by German Industrial Standard No. 58400 (draft September 1963).

New

Translation of
German Application

The invention is discussed with reference to the drawing in three embodiments.

Fig. 1 shows the reference profile of the normal section (rack profile) of a one-toothed pinion,

Fig. 2 shows the reference profile of the normal section (rack profile) of a two-toothed pinion,

Fig. 3 shows a one-toothed pinion in perspective,

Fig. 4 shows a two-toothed pinion in perspective,

Fig. 5 and Fig. 6 show the reference profile of two complementary profiles for stepping up,

Fig. 7 shows a gear mating for stepping up,

Fig. 8 shows an efficiency diagram of the transverse section for contact beginning and contact end.

In the profile of Fig. 1 the module m, as usual, is taken as standard; all dimensions except for the degree designations are therefore to be multiplied with the module in mm. The line MM is so located that the tooth thickness = the space width = the half pitch $t_o/2$. The pitch t_o amounts to 3.14159 module. The tooth crown is 0.25 module high, the root is 1.1 module deep; the tip clearance is 0.2 module.

A gear helical-toothed according to these measurements in the hob method is shown in Fig. 3. The tooth width is about 6 module, the angle of skew on the pitch cylinder $\beta_0 = 15.2°$.

The smallest angle of skew necessary for the *Ueberwachung* (monitoring, control, inspection??) is calculated according to the formula $\sin \beta = \pi m/2b$ (m = module, b = tooth width);

U. S. Patent

Three examples of the invention are illustrated in the accompanying drawing, wherein:

FIG. 1 is the basic rack profile in normal section for a pinion having a single tooth;

FIG. 2 is the basic rack profile in normal section for a pinion having two teeth;

FIG. 3 is a perspective view of a pinion having a single tooth;

FIG. 4 is a perspective view of the pinion having two teeth;

FIGS. 5 and 6 illustrate the two complementary basic profiles for a step-up combination;

FIG. 7 illustrates a step-up combination, and

FIG. 8 is a graph showing the basic course of the efficiency of the step-up gearing according to FIG. 7.

In the profile according to FIG. 1, the module m is, as usual, taken as the reference parameter. All the measurements except the angles will be in millimetres when multipled by the module. The chain dotted line M—M is located so that the tooth thickness is equal to the tooth gap and equal to half the pitch t_o. The pitch t_o amounts to 3.14159 modules. The addendum is 0.25 module, the dedendum 1.1 module and the bottom clearance 0.2 module.

A helical gear made with these dimensions by a hob milling process is illustrated in FIG. 3. The face width amounts to about 6 modules; the helix angle at the pitch cylinder $\beta_o = 15.2°$. By using the helical tooth form, a transverse contact ratio larger than 1 is obtainable for the gear combination as a whole even though the transverse contact ratio in any one lamina plane of the combination is less than 1. The minimum helix angle necessary for engagement is limited by the formula

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_o < 1.5$$

Substantially different, and more definite.

in order to keep the axial force of the gears small, a small angle of skew is desirble; such a one also works out favorably on the flank shape of the gears in the production with gear hobbers.The lead, i.e., the pitch circle arc between the two pitch cylinder generatrices through the points of intersection of a flank line with the two faces of the toothing, is so chosen with a ratio of lead of the mating of $\epsilon > 1$ results. As mating profile a standard profile can be used and with particularly good results the 58 400 for precision engineering; here, with a lead of a half pitch $t_o/2$ on a gear with 30 teeth and a spiral angle of $\beta_0 = 15.2°$ a lead ratio of $\epsilon = 1.1$ results.

Precision engineering standard profile 58400 behaves, with reference to the flanks involved in the power transmission, compelentarily to the reference profile of Fig. 1, i.e., the pinion gear of Fig. 1 or 3 has a small crown and a large root, while the gear meshing with this pinion relative to parts involved in the power transmission has a large crown and a small root. Thus in standard profile 58400 a part of the flank of the root available for the power transmisssion in the gear mating in question is not utilized; this unused part can, however, be made useful if used with an additional gear. Of course, it is also possible to provide a reference profile that has a small root to begin with. Such a gear would have the advantage of the somewhat greater solidity and the disadvantage that it can be mated only with the pinion gear as per Fig. 1 or 3.

In order to keep the axial forces on the gears to a minimum, a small helix angle is desirable. In addition, a small helix angle has a favourable effect on the form of the sides of the gears if they are made with a hob milling machine. The spread, i.e. the arc of the pitch circle between the two pitch cylinder lines through the points of intersection between a line passing through a side of the tooth and the two normal faces of the gearing, is chosen so that the transverse contact ratio ϵ of the combination is larger than 1. The mating profile can be a standard profile, preferably according to German Industrial Standard 58400 draft September 1963 for the precision industry. For the case where the pinion has one tooth ($z = 1$), the spread is half the pitch ($t_o/2$), the wheel has 30 teeth and the helix angle β_o is 15.2°, the transverse contact ratio ϵ will be equal to or larger than 1.1.

The standard profile for the procision industry according to German Industrial Standard No. 58400 is complementary to the basic profile of FIG. 1 in respect of the sides of the teeth involved in power transmission, i.e. the pinion of FIGS. 1 or 3 has a small addendum and a large dedendum, whilst the mating wheel has a large addendum and a small dedendum as far as the portions involved in power transmission are concerned. Thus, in the case of the standard profile according to German Industrial Standard 58400 draft September 1963, a portion of the dedendum available for power transmission is not used in the gear combination in question. This unutilised portion can, however, be utilised in co-operation with another gear. Naturally, it is also possible to provide a basic profile which has a small dedendum to begin with. Such a gear has the advantage of being somewhat stronger but the disadvantage of being useful only in combination with the pinion of FIGS. 1 or 3.

Translation of
German Application

The reference profile of Fig. 2 has a somewhat larger crown than that of Fig. 1, namely, of 0.4 module and a somewhat greater tip clearance (root radius tooth fillet) of 0.3 module. The therewith associated pinion gear (Fig. 4) likewise has a lead of a half pitch $t_o/2$, the minimum tooth width being about 6 module;

=

the spiral angle is 15.2°. The pinion of Fig. 4 can likewise be mated with a helical gear that is produced according to precision engineering standard profile 58400. The reference profile of Fig. 2 is likewise a complementary profile to precision engineering standard profile 58400. It is possible, though a little less advantageous, to use a helical gear according to DIN 867 as mating gear.

Fig. 5 shows a reference profile for gearing for stepping up a rotary motion. In it, m designates the module, to the pitch $\alpha_0 = 30$, the pressure angle $S_K = 0.1$ m the tip clearance. The profile reference line MM, indicated by dash-dot line, is so located that tooth thickness and tooth space are equal. The point P marks the end of the driving flank of the rack profile. Fig. 6 shows a reference profile complementary to the reference profile of Fig. 5. The designations are the same as in Fig. 5.

=

U. S. Patent

The basic profile of FIG. 2 has, in relation to that of FIG. 1, a somewhat larger addendum, namely 0.4 module, and a somewhat larger bottom clearance of 0.3 module. The mating pinion (FIG. 4) likewise has a face advance of half the pitch ($t_O/2$). The minimum face width is obtained by the formula

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_o < 1.5$$

U.S. case substantially augmented to provide specific data.

The helix angle is 15.2°. The pinion of FIG. 4 can likewise be combined with a helical gear made according to German Industrial Standard 58400 draft September 1963. The basic profile of FIG. 2 is also complementary to the profile of German Standard 58400 draft September 1963. Further, it is possible, although less advantageous to use a mating helical gear according to German Industrial Standard No. 867.

FIG. 5 shows the basic profile for a gear in a step-up combination. m represents the module, to t_o the pitch, $\alpha_o = 30°$ half the angle of the side, $S_K = 0.1\ m$ the bottom clearance. The reference line M—M represented by a chain dotted line is located so that the tooth thickness and tooth gap are equal. The point P designates the end of the useful tooth surface of the basic rack profile. FIG. 6 illustrates a basic profile complementary to the basic profile of FIG. 5 and the same references are used as in FIG. 5.

Translation of
German Application

A gear mating composed of helical gears corresponding to the reference profile of Figs. 5 and 6 is shown in Fig. 7. The smaller gear (pinion gear 1) has six teeth, while the gear 4 has 60 teach. Of individual teeth of pinion gear 1 front surfaces 2 and back surfaces 3 are indicated, of individual teeth of the gear 4 front surfaces and back surfaces 6 are indicated. The ratio of lead of a *Schichtelement* (layer/coating element?) is 0.7, taking into consideration the ratio of lead, the entire overlap amounts to 1.2. The direction of rotation of the gears 1 and 4 is indicated by the arrows 7 and 8; this results in a stepping-up of a rotary motion.

The length of contact E1, E2, E3 lies, with reference to the line M1, M2 for the greater part on the right side, i.e., on the side of the contact end. At the beginning of the tooth contact (shock friction) the teeth surfaces still rub only a little on each other, since the point E1 lies close to the center line M1, M2, while at the contact end (pulling friction), at point E3 the stronger sliding of the tooth surfaces on each other does less damage. In Fig. 8, the instantaneous degree of efficiency η over the friction value μ for a normal straight gear mating and for a Schichtelement of the gear mating according to the invention is shown. Although the number of teeth of the gear mating produced according to the invention is smaller, the efficiency for the transmission is better. The curve paths z1/z2 – 60/6 are valid for a *Schichtelement* of the gear mating of the invention according to Fig. 7, the curve parts z1/z2 = 80/8 are valid for a normal straight gear mating with 80 and 8 teeth respectively.

U. S. Patent

A gear combination consisting of helical gears corresponding to the basic profiles of FIGS. 5 and 6 illustrated in FIG. 7. The pinion 1 has four teeth and the wheel 4 has forty teeth. The drawing shows the front faces 2 and the rear faces 3 for the pinion 1 and the front faces 5 and rear faces 6 for the wheel 4. The transverse contact ratio for a laminate amounts to about 0.7 and when considering the face contact ratio the total engagement factor is 1.2. The direction of rotation of the gears 1 and 4 is represented by the arrows 7 and 8, respectively; thus, the illustrated version is a step-up gearing. The line of action E1, E2 is located principally on the righthand side of the line M1, M2, i.e. on the side adjacent the point of final engagement. Upon commencement of engagement (pushing friction) the sides of the teeth slide on one another only to a small extent because the point E1 lies close to the centre line M1, M2, whereas upon termination of engagement (pulling friction) at the point E2 the more intensive sliding of the tooth sides upon one another is less detrimental. FIG. 8 is a graphical representation of the momentary efficiency relatively to the coefficient of friction μ for a conventional gear combination (a) and for a laminate of the gear combination according to the invention (b). Although the number of teeth in the combination according to the invention is less, the efficiency is higher.

Translation of
German Application

The curve paths for the contact beginning are solid, while the curves for the contact endings are dashed. As can be seen from the representation, the curve paths for the gear mating of the invention according to Fig. 7 (are) closer together than in any previous normal gear mating; above all, the decrease in the degree of efficiency under increasing friction value is not so great with reference to the contact beginning and is always far above zero. This represents a great advantage because a jamming of the gears at the beginning of contact in the embodiment of the invention does not occur even with friction value $\mu = 1.0$. It is shown, therefore, that the gearing of the invention is especially suitable for overcoming difficult operating conditions under which the friction value is especially high as a result of infrequent maintenance of the gearing or because of the presence of sand or dust in the atmosphere. Valid here also are the diagrams for a *Schichtelement* of the frontal section (*Stirhschnitt*).

The curves for commencement of engagement are shown in full lines whilst the curves for termination of engagement are shown in broken lines. As evident from FIG. 8, the curves for the gear combination according to FIG. 7 lie closer to one another than the corresponding curves for conventional gear combinations. In particular, the drop in efficiency η upon an increase in friction μ is not so great upon commencement of engagement and always lies considerably above zero. The principal advantage of this is that jamming of the gears upon commencement of engagement is avoided with the construction according to the invention even with a coefficient of friction $\mu = 1.0$. Accordingly, the gear combination according to the invention is particularly suitable for difficult operating conditions in which the coefficient of friction may become particularly high as a result of infrequent servicing and/or the presence of sand or dust in the atmosphere. The graphs for a lamina normal section also apply in this case.

The general limitations for the helix angle β_o have been mentioned previously. In a step-down combination

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_o < 0.4z_v + 2,$$

whereas in step-up combination

$$0.6 < \frac{b}{m_n} \sin \beta_o < 1.5$$

For the profile deviation x of the pinion

$$0 < x < -0.35z_v + 2.5$$

in a step-down combination and

$$x < 0$$

in a step-up combination and in general

$$-0.125z_v + 0.2 < x < -0.35z_v + 2.5$$

All this (plus lines 1-4 in Col. 5) is new. This has no counterpart in Roth's German Patent application.

No counterpart
in German Application

The following are practical values for the profile deviation.

Step-down gearing:

Five teeth on pinion, $x = +0.7$
Four teeth on pinion, $x = +0.88$
Three teeth on pinion, $x = +0.92$
Two teeth on pinion, $x = +0.98$
One tooth on pinion, $x = +1.03$

Step-up gearing:

Three teeth on pinion, $x = -0.2$ and thus $x = +0.3$ for the wheel
Four teeth on pinion, $x = -0.15$ and thus $x = +0.5$ for the wheel
Five teeth on pinion, $x = -0.22$ and thus $x = +0.5$ for the wheel

The following values are examples for the addendum and dedendum in step-down gear combinations.

Addendum for the driver, useful dedendum for the driven:

One tooth on pinion	0.25
Two teeth on pinion	0.4
Three teeth on pinion	0.5
Four teeth on pinion	0.6
Five teeth on pinion	0.7

The addendum of the driven gear and the corresponding dedendum of the driving gear may be 1.1 in this case.

For step-down gear combinations the driving gear may have an addendum of 0.4 and a dedendum of 1.0, without any modifications.

The addendum as referred to above is given by

$$h_k = \tfrac{1}{2}[d_k - (z + 2x)m]$$

wherein d_k = diameter of addendum circle, z = number of teeth, x = profile deviation factor and m = module.

All this (plus lines 1-4 in Col. 5) is new. This has no counterpart in Roth's German Patent application.

B-18

No counterpart
in German Application

The profile deviation xm is the displacement of the reference line of the cutting tool from the pitch circle of the wheel. The reference line of the cutting tool is located where the tooth thickness is equal to the tooth gap.

Continuation of extensive new addition.

What I claim is:

1. A combination of involute gears in which the shafts of the two gears are parallel to one another and wherein the virtual number of teeth on the pinion is no more than five, comprising the following features:

(a) Both gears are helical and the helix angle is given by

$$-0.35z_v + 1.4 < \frac{b}{m_n} \sin \beta_0 < 1.5$$

wherein β_0 = helix angle at the pitch cylinder, m_n = module, b = minimum tooth width and z_v = virtual number of teeth;

(b) the pinion has a small addendum and a large useful dedendum (difference between useful height of tooth and addendum) if it is the driver, or a large addendum and a small useful dedendum if it is the driven, the profiles of the combination being complementary in respect of the tooth sides involved in power transmission;

(c) there is a profile deviation which is positive for the pinion in a step-down combination but negative in a step-up combination, and positive for the wheel in a step-up combination.

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No. 84-1568

In the Supreme Court of the United States

OCTOBER TERM, 1984

QUAKER CITY GEAR WORKS, INC.
and KARLHEINZ ROTH,
Petitioners,

vs.

SKIL CORPORATION,
Respondent.

On Petition For A Writ Of Certiorari To The
United States Court of Appeals For the Federal Circuit

BRIEF FOR RESPONDENT IN OPPOSITION

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QUESTIONS PRESENTED

Petitioners would have us believe this is a case in which the lower and appellate courts usurped the jury function by "reweighing" evidence and by substituting the courts' choice as to which party should prevail, all in disregard of Petitioners' Seventh Amendment rights to a jury trial. Petitioners further argue that there is a split among the circuits concerning the standard of appellate review of jury verdicts and that in "reweighing" the evidence, the Court of Appeals for the Federal Circuit applied the wrong standard.

Petitioners have misconstrued the opinion of the Federal Circuit and have erroneously equated the terms "review" with "reweigh". Further, there is no conflict among the lower courts as to the standards of review for a case like this one.

In truth, Petitioners are simply upset because the district court and the Federal Circuit declined to summarily "rubber stamp" the jury verdict — if indeed there was one in this case. Petitioners would have the lower courts abdicate their judicial responsibility of comprehensively reviewing the trial proceedings to assure that all parties, not just Petitioners, received a proper and fair jury trial.

A careful reading of the opinions below establishes that the district court and the Federal Circuit studiously avoided reweighing the evidence or determining witness credibility or substituting their own findings for those of the jury. In particular, the Federal Circuit applied a very limited standard of review, a standard highly deferential to the findings of a jury.

Petitioners have not raised a proper issue warranting this Court's attention and are not entitled to the requested relief in any event.

STATEMENT UNDER RULE 28.1

Respondent, Skil Corporation, is a wholly owned subsidiary of Emerson Electric, Inc., a Missouri corporation.

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SKIL CORPORATION,
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On Petition For A Writ Of Certiorari To The
United States Court of Appeals For the Federal Circuit

BRIEF FOR RESPONDENT IN OPPOSITION

STATEMENT OF THE CASE

Since Petitioners have not stated the case fully, we must begin with a supplemental statement of the case.

This is a suit brought by Petitioners Karlheinz Roth ("Roth") and Quaker City Gear Works, Inc. ("Quaker") against Respondent Skil Corporation ("Skil") for patent infringement. Following a jury trial, the trial court entered a judgment for Respondent on the ground that

the patent was invalid for failing to comply with the requirements of 35 U.S.C. § 112. On appeal, the Federal Circuit, while finding certain procedural irregularities by the trial court, affirmed its holding of invalidity under Section 112.

A. The Parties

Petitioner Roth, a citizen and resident of West Germany, is the patentee and licensor of the patent-in-suit. Petitioner Quaker, a manufacturer of gears, is the exclusive United States licensee of the Roth patent-in-suit. Respondent Skil is a manufacturer of a line of power tools and component parts, including gear systems, for use in its power tool products.

B. The Proceedings In The District Court

Petitioner Roth was called as an adverse witness by Respondent. Roth testified that the September, 1963 Draft of the German technical specification, DIN 58400, was necessary to the design of the gear wheel comprising the patented combination. (There are numerous references to this German language specification in Roth's United States patent; however, Petitioners were unable to locate or produce the German document.)

At the close of the testimony, the case was submitted to the jury on twenty-one special verdicts under Rule 49(a), Federal Rules of Civil Procedure.* The jury

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* The present action was tried to a jury notwithstanding Respondent's frequently articulated concern that the complex nature of the subject matter, including a double algebraic and trigonometric inequality in the claims, would be beyond the comprehension of the jury.

could not agree on the answer to two of the special verdicts (Nos. 2 and 12) and failed to answer a third (No. 10), which is pivotal on the issue of obviousness. Judge Green indicated he was not entering a verdict and requested the parties to file suitable motions. Skil then filed its motion under Rule 50(b).

Judge Green wrote a Memorandum Opinion and entered judgment in favor of Respondent on the ground of patent invalidity. Specifically, Judge Green found that the draft German technical standard (DIN 58400, September, 1963) was essential material for the design of the gears at issue and held that the omission of this standard from the patent disclosure rendered the patent invalid under 35 U.S.C. § 112. In reaching his conclusion that the omitted standard was essential material, the judge observed that since "no interrogatory was requested or submitted to the jury" on this issue, the court was free under Rule 49(a) to make its own fact finding.

C. The Proceedings Before The Court of Appeals

The Court of Appeals for the Federal Circuit cautioned that a trial court is not free to make a specific finding under Rule 49(a) contrary to "an implicit and inherent finding of the jury within a broader question" but could set aside such a finding only if it were not supported by substantial evidence. The Federal Circuit, however, determined that Judge Green's handling of the "essential material" question constituted only a "procedural irregularity" which did not affect the outcome (A-29). The Federal Circuit reviewed the trial record and concluded that it lacked substantial evidence upon which reasonable persons could conclude that the German technical standard was not essential material.

ARGUMENT

Petitioners have framed the "Questions Presented" as involving the standards for deciding a motion for a Judgment Notwithstanding the Verdict. Although the standards applied by trial judges and appellate courts in reviewing a jury's factual determinations are substantially identical, the inquiry here, in view of the Federal Circuit's treatment of this case (affirming the lower court), centers on the role of the Federal Circuit in discharging its appellate review responsibilities. Indeed, Petitioners implicitly recognize this fact as their arguments are directed almost exclusively to the conduct of the Federal Circuit rather than the conduct of the district court.

A careful review of the Federal Circuits' treatment of the present case reveals that the court studiously avoided "reweighing" evidence; assessing witness credibility; or substituting its choice for that of the jury.

I. Reviewing Is Not Reweighing; An Appellate Tribunal Should Comprehensively Review The Entire Record To Assure That The Jury Has Engaged in Rational Decision Making And That The Jury Trial And Due Process Rights Of None Of The Parties Have Been Compromised

Petitioners raise the spectre that the Federal Circuit, in exercising its appellate review function, has deprived Petitioners of their Constitutional right to trial by jury. Petitioners fail to recognize that the role of appellate review in jury cases serves the interests of all parties

by assuring that no party is denied this Seventh Amendment right.

In an attempt to obtain a rehearing of their case by this Court, Petitioners have characterized the Federal Circuit's comprehensive review of the entire trial record as an impermissible "reweighing" of trial evidence. It hardly requires comment that the terms "review" and "reweigh" are not synonymous — a review of the record to confirm the existence or lack of substantial evidence in support of the jury's findings does not constitute a reweighing of that same evidence.

It is difficult to perceive how an appellate court could otherwise discharge its duty to protect the Constitutional interests of all parties if it were proscribed from reviewing all that transpired below. In short, to fail to review is to abdicate this important appellate mandate and to place the fate of the parties, uncritically, into the hands of a lay jury, which does not always act rationally, particularly when the issues are highly technical and complex as is the case here. The substantive rights of the parties are subjected to far greater jeopardy by an unbridled exercise of jury decision making than by the reasoned opinion of reviewing courts. In balancing the competing Constitutional interests of the parties, the appellate court should err, if at all, on the side of greater scrutiny and review. This Court should not discourage appellate tribunals from comprehensively reviewing the record and from declining to summarily "rubber stamp" the proceedings below, however egregious and irrational they may prove.

II. The Federal Circuit Eschewed Reweighing The Evidence; Substituting Its Choice For That Of the Jury; and Determining Credibility of Witnesses

Petitioners' criticism of the Federal Circuit is puzzling in view of the strong deference to jury determinations of fact shown by that court. In reviewing the record on the issue of substantial evidence, the Federal Circuit continued to show its strong deference to the jury by indicating that it would "(1) consider all the evidence; (2) in a light most favorable to the non-mover; (3) drawing reasonable inferences favorable to the non-mover; (4) without determining credibility of witnesses; and (5) without substituting its choice for that of the jury between conflicting elements in the evidence" (A-31). Surely, these standards are in harmony with the standards set forth by this Court and by the various courts of appeals throughout the federal judicial system.

In determining the standards governing the grant or denial of a motion for a judgment N.O.V., the Federal Circuit in the case at bar cited (A-31) its earlier decision in *Connell* v. *Sears, Roebuck & Co.*, 722 F.2d 1542 (1983). In the *Connell* case, the court wrote:

> "Jury verdicts must be treated with great deference. The Seventh Amendment to the Constitution preserves the right to trial by jury in suits of common law and also provides that United States Courts shall not re-examine facts tried by jury except under the rules of common law. With the merger of law and equity, denial of the right in certain types of cases ceased. Permitting the jury to draw legal conclusions based on the jury's fact findings and reached in light of instructions on the law has been preserved as part of the right. The court, although it remains ultimately responsible for upholding the law applicable to the facts found, cannot substitute its view

> for that of the jury when to do so would be an effectual denial of the right to trial by jury.
>
> Deference due a jury's fact findings in a civil case is not so great, however, as to require acceptance of findings where, as here, those findings are clearly and unquestionably not supported by substantial evidence. To so hold would be to render a trial and the submission of evidence a farce" (*Id.* at 1546).

Certainly, the Federal Circuit's standards for the grant or denial of a motion for a judgment N.O.V. comport with decisions of this Court. In this respect, this Court stated in *Continental* v. *Union Carbide,* 370 U.S. 690, 696 (1961), that — "[t]he Court of Appeals was, of course, bound to view the evidence in the light most favorable to Continental [against whom the jury verdict was rendered] and to give it the benefit of all inferences which the evidence fairly supports, even though contrary inferences might reasonably be drawn."

In *Continental* v. *Union Carbide, supra,* this Court quoted (370 U.S. 696, n6) from 5 *Moore's Federal Practice* 2316 (2d Ed., 1951) as follows:

> "In ruling on the motion [for directed verdict] the trial court views the evidence in the light most favorable to the party against whom the motion is made. On appeal, likewise, the appellate court must consider the evidence in its strongest light in favor of the party against whom the motion for directed verdict was made, and must give him the advantage of every fair and reasonable intendment that the evidence can justify."*

---

* Of course, the standards for entering judgment notwithstanding the verdict are the same as the standards for directing a verdict; see 5A *Moore's Federal Practice,* ¶50.02[2], p.50-76.

It is also pointed out in *Moore's* that — "what the cases reveal is not a difficulty of ascertaining a proper standard but a difficulty in applying the standard to the varying facts of the individual cases" (5A *Moore's Federal Practice,* ¶50.02[1], p.50-39.*) In the present case, it is clear the Federal Circuit applied the standard as set forth by this Court in *Continental* and reached the correct result.

Manifestly, the Federal Circuit has no intention of usurping the jury function and will affirm a judgment N.O.V. only where, "after following those [the above] guidelines, the court is convinced upon the record before the jury that reasonable persons could not reach or could not have reached a verdict for the non-mover" (A-31). Equally clear, however, the Federal Circuit has shown that it does not intend to abdicate its appellate responsibilities by rubber stamping jury verdicts without first being satisfied that the verdict is supported by the substantial evidence.

III. The Evidence Considered By The Federal Circuit

To all but eliminate the issues of witness credibility and reweighing of conflicting elements of evidence, the Federal Circuit assumed for the purposes of its review that "the jury wholly discredited the testimony of Skil's experts that the disclosure was not enabling . . ." (A-32). Thus, the court restricted its review to Petitioners' own evidence.

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* Incidentally, the current edition of *Moore's* contains virtually the same language as that quoted by this Court from the 1951 Edition in *Continental* v. *Union Carbide, supra.* (See 5A *Moore's Federal Practice,* ¶50.02[1], p.50-33, 4 & 5.)

What was considered pivotal by both the trial court and the Federal Circuit was Petitioner Roth's own admission that the omitted and unavailable German DIN specification *was* necessary to the design of the wheel comprising the claimed gear combination (A-32). The jury was obliged to accept the inventor's and Petitioner's own admission, although contrary to his interest. In addition, documentary evidence in the form of letters between Petitioner Roth's own United States and German patent counsel convincingly supported Roth's admission concerning the significance of the omitted reference. (A-20-22, 32-33). Again, reasonable jurors could not conclude that the missing German paper was not essential in the face of this evidence.

Thus, the Federal Circuit had no occasion to determine witness credibility, reweigh evidence, or substitute its own choice for that of the jury. Rather, the appellate court below reviewed the record, disregarding the testimony of Respondent's witnesses, and found that Petitioners' own evidence established the absence of substantial evidence upon which reasonable persons could have reached a verdict for Petitioners.

IV. The Findings Of The Present Jury Are Entitled To Little Or No Weight

One final matter requires comment. Much has been said of the role of the jury, both generally and specifically, in this case. Indeed, it is Petitioners' very contention that they have been deprived of their Constitutional right to a jury trial by reason of the Federal Circuit's affirmance of Judge Green's judgment N.O.V. On the other hand, Respondent has countered by noting that this Constitutional right is a two-way street shared by both

parties and, additionally, must be balanced against any other Constitutional right, that of due process.

Petitioners' claim before this Court is premised upon the critical assumption that the jury, in fact, found for Petitioners on all issues properly submitted to it. Respondent has not, until now, quarreled with this assumption for the reason that whatever was the true character of the jury verdict in this case, it does not affect the judgment as affirmed by the Federal Circuit.

As outlined hereinafter, however, Petitioners' reliance on the jury's fact findings is not well founded. It is all too clear that this jury did not understand the subject matter before it; did not engage in rational decision making; and did not make fact findings on all of the issues submitted to it for resolution, particularly on the very fact issue which was critical to the lower courts legal conclusion that the Roth patent is invalid. Indeed, but for the dispositive treatment of this case by Judge Green and the Federal Circuit under 35 U.S.C. § 112, the case would require remand for retrial because of the jury's role in the present litigation.

The inconsistency and irrationality of the jury's special verdict answers cannot be dismissed as easily as suggested by Judge Green when pointing out that they reflect an overall "intent to return a verdict" for Petitioners (A-11). In this regard, the district court did concede that — "[i]t is true that the jury's answers do not appear entirely consistent" (A-11). To ignore the obvious implications of the jury's irrational responses and grant judgment for Petitioners would constitute a deprivation of Respondent's Constitutional due process and jury trial rights far more egregious than the alleged "reweighing" of evidence by the court below.

Consideration of the jury's response to special verdict No. 1 is all that is required to establish beyond doubt the absence of any reasoned comprehension by the jury in this case. This verdict merely asks the jury to identify which of the listed references comprise part of the scope and content of the prior art applicable to the patented gear combination (A-1). However, the jury found that not a single one of these references was even part of the prior art (A-1). Thus, Judge Green properly concluded that "the jury's failure to find that any of the references listed in Interrogatory #1 were prior art seems inconsistent with the evidence of both parties" (A-11). The Federal Circuit also realized that the jury did not understand the evidence "since it was undisputed that" the references of Special Verdict No. 1 were part of the prior art (A-34). In view of the response to verdict No. 1, a reasonable argument simply cannot be made that this jury understood the issues and engaged in rational, reasoned decision making.

The jury's failure to grasp the elementary concept of Special Verdict No. 1 made it impossible for the jury to engage in a reasoned analysis of a number of the other special verdicts. Special verdict No. 1 is one of the all-important factual predicates under *Graham* v. *Deere*, 383 U.S. 1, to a determination of non-obviousness under 35 U.S.C. § 103. Indeed, special verdict No. 10, the principal "obviousness" special verdict, was jettisoned as "not applicable" (A-4) because of the jury's apparent inability to find any of the patents and publications of verdict No. 1 within the scope and content of the applicable prior art.

The scope and content of the prior art was not the only factual underpinning of obviousness set forth in

Graham that the jury was asked, but unable, to resolve. The jury could not agree on an answer to special verdict No. 2 (A-1,2) which asked the jury to determine the level of ordinary skill in the gear art.

The jury's failure to agree on an answer to special verdict No. 12 casts further doubt on the jury verdict in this case.* As noted by the Federal Circuit, verdict No. 12 "appears to be more precisely directed to enablement" under 35 U.S.C. § 112 (A-3, footnote 8), which was the legal ground for the holding of invalidity! Consequently, Petitioners' reliance on verdict No. 11 as establishing compliance with Section 112 is certainly misplaced. In short, Petitioners never actually had a jury finding or verdict, special or otherwise, in their favor on any of the factual issues underlying the various legal grounds of invalidity and non-infringement, including the very legal ground on which the J.N.O.V. was granted.

CONCLUSION

The Federal Circuit did not, as suggested by Petitioners, engage in a *de novo* "reweighing" of the evidence. Nor did the Federal Circuit undertake to assess the credibility of witnesses or to substitute its choice for that of the jury. To the contrary, the Federal Circuit exhibited great deference to the findings of the jury. In this

* Special verdict No. 12 has not been reproduced correctly as part of the Federal Circuit's opinion (see 747 F.2d 1451) at A-24 of Appendix A to the Petition. On that page, it appears that the jury answered Special Verdict No. 12 as "yes". However, the jury did not answer No. 12 as indicated at A-5 of Appendix A.

connection, the appellate court below engaged in a complete review of the record to verify the absence of substantial evidence to support the jury's limited "findings". By discounting completely Respondent's witnesses and looking only to Petitioners' testimony and documentary evidence, the Federal Circuit properly affirmed the lower court's judgment of invalidity in accordance with settled guidelines of this Court which are followed throughout the federal judicial system.

There is no support for Petitioners' contention that they have been deprived of their Constitutional right to trial by jury and, consequently, the Petition inviting this Court to review these issues, for the fourth time, should be denied.

Respectfully submitted,

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October Term, 1984

No. 84-1568

QUAKER CITY GEAR WORKS, INC., *et al.*,
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SKIL CORPORATION,
Respondent.

PETITIONERS' REPLY BRIEF

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IN THE

SUPREME COURT OF THE UNITED STATES

October Term, 1984

No. 84-1568

QUAKER CITY GEAR WORKS, INC., *et al.*,
Petitioners,

v.

SKIL CORPORATION,
Respondent.

PETITIONERS' REPLY BRIEF

Quaker City's petition presents three distinct questions for the Court's consideration. Respondent's brief in opposition deals to some extent with the second question (concerning reweighing of the evidence); it barely touches the first question (on the evidence to be considered on a motion for judgment n.o.v.), and totally disregards the third question (on the significance of direction of burden of proof as to the contested issue). What respondent interjects instead of dealing directly with these questions are (1) its manifestations of its distrust of jury trials (pp. 2 (f.n.), 4-5 and 9-12), and (2) a strained attempt to demonstrate how the evidence could support a finding made by the appellate court if distorted to serve respondent's purpose.[1]

1. Respondent's brief in opposition also avoids comment on the pre-disposition of the Federal Circuit Court of Appeals to give little if any weight to opinions handed down by other Courts of Appeals, as taken up in the Petition at pages 5, 6 n. 1, 11 and 14. In a specially concurring Opinion in *Weinar v. Rollform, Inc.*, 744 F.2d 797, 811 (Fed. Cir. 1984), Senior Judge Nichols deplored the lack of attention to cases from other Circuits. He expressed concern that the Federal Circuit Court's "exclusive jurisdiction, over certain areas of law, is not to be construed as a legislative direction to ignore the efforts of other courts to deal with the same problems, efforts exerted when over many years they shared the responsibility that is now ours."

Central to the decision by the Court of Appeals for the Federal Circuit is its fact finding — a finding, opposite to that of the jury, as to whether a person skilled in the art is enabled by the United States patent, without necessity of a DIN 58400 paper mentioned in it, to make and use the invention described in the patent in suit.

As the Court of Appeals for the Federal Circuit recognized, the jury decided this fact question in the affirmative. The District Court, mistakenly believing the jury had not made a finding on this question, and therefore believing itself free under Rule 49(a) to make its own fact finding, adjudging witness credibility and drawing its own inferences, reached *its* fact finding opposite to that of the jury.[2]

On pages i, 4, 5, 6, 9 and 12, respondent Skil challenges the reference to the action of the Court of Appeals as reweighing the evidence on the question of "essential material." This does not withstand scrutiny. As the Court of Appeals for the Federal Circuit correctly observed, the jury made the inherent finding that the unavailable German paper was not essential material to the U. S. patent, by its affirmative answer that said U.S. patent provides enabling disclosure. (App. A, pp. A-28 and A-29). That

2. An inference in favor of the moving party Skil and against Quaker City was drawn by the *District Court* in arriving at *its* fact finding of essential material to the patent, as follows:

> "In light of all the evidence, particularly Prof. Roth's testimony that the German Standard was 'necessary' to design the wheel used *in a related German patent* [sic, application], I find that the German Standard was *'essential material' for the design of the Patent at issue here* as well."

(App. A, p. A-10).

Either a similar inference was drawn by the Court of Appeals for the Federal Circuit in reaching *its* own finding of fact of "essential material" opposite to the jury's, and fatal to Quaker City, or the Court of Appeals ignored the extensive differences between the U.S. patent and the far shorter, different, German patent application as to which, and *only* as to which, Roth was examined concerning DIN 58400.

finding by the jury resulted from its weighing all the evidence pro and con enabling disclosure in the U.S. patent, as urged by respondent Skil *and* instructed by the court (App. A, pp. A-79-82).[3]

The District Court, being unaware that this finding of fact had already been made by the jury, deemed itself to be performing initial weighing (not a *re*-weighing) of the evidence on the essential material question (App. A, pp. A 9-10). From the District Court's prefatory explanation that it believed Fed. R. Civ. P. 49(a) to authorize this, it may be inferred that the District Court could well have been reluctant to overturn a jury finding if already made to the effect that the German paper mentioned a few times in the U.S. patent was *not* essential material to it — i.e., that the U.S. patent itself does provide enabling disclosure without necessity of obtaining that paper.

The jury having determined that the German paper was *not* essential material *to the U.S. patent*, and this being a fact question, the Court of Appeals for the Federal Circuit reached its opposite finding of fact upon its *reweighing* of the evidence. (App. A, pp. A-29 to A-33, inclusive). This reweighing involved some evidence portions which the Court of Appeals deemed to support, directly or by inferences, the conclusion it reached, i.e., its finding of fact that the German paper as referred to in the U.S. patent was essential material *to that patent*, resulting in patent invalidity for lack of enabling disclosure.

Tacitly recognizing that there is no disputing the very extensive contrasts between the Roth German application and the far more complete, self-sufficient U.S. patent in suit, referred to in the petition at page 6, note 2, and demonstrated in Appendix B, double-pages B-9 to B-18, respondent relies instead on so inaccurately restat-

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3. As the trial court instructed the jury concerning interrogatory 11 (to which the jury's answer was affirmative), ". . . there has been lot — a lot of evidence as to this particular issue and it's for your determination." (App. A, p. A-81).

ing the facts of this case as to blur the subject of Roth's testimony under scrunity.

Contrary to respondent's statements on page 2, Roth was not examined as to whether a DIN 58400 paper would be necessary along with *the U.S. patent* — he gave no testimony about that aspect of the U.S. patent. He was asked the two questions at the bottom of page A-63 only in regard to his earlier, less complete German patent application about which he was being questioned, and only in respect to an unspecified earlier draft of DIN 58400 — not the September, 1963 draft which respondent incorrectly reports as having been the subject of Roth's testimony. Roth neither was questioned about that September draft nor testified about it.

On page 2, while purporting to correct or supplement petitioners' statement of the case, respondent mischaracterizes Roth as the licensor and Quaker as licensee of the Roth U.S. patent. Yet, at the trial, it was respondent which adduced evidence of Quaker's ownership of the patent, Quaker having purchased it some eleven months before the trial.

These misstatements as to the facts on page 2 culminate in respondent's mischaracterizations on page 9, where it persists in slurring over the separate facts as to the U.S. patent and a stated draft of DIN 58400 to which *it* refers, and the contrasting, far less complete and less accurate German application in which are included unspecific references to DIN 58400.[4] Straining to maximize its reliance on this distorted picture, respondent characterizes Roth's testimony at the bottom of page A-63 of Appendix A as Roth's "own admission, although

4. The completeness and specific numerical examples in the U.S. Patent, in contrast to the German application, are shown in side-by-side comparison in Appendix B, double-pages B-9 to B-18, inclusive. The mentions of DIN 58400 in the German application occur on the left-hand pages of B-13 and B-14. Copies of some drafts of DIN 58400 were produced during discovery and were made exhibits for identification by respondent.

contrary to his interest." (Respondent's brief, page 9) This exposes the need for having seemingly lost sight on page 2 of the proven fact that Quaker had acquired the ownership of the U.S. patent long before Roth was called as a witness at trial by respondent.[5]

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On pages 12-13, respondent argues that the Court of Appeals for the Federal Circuit did not engage in "*de novo* 'reweighing' of the evidence," charitably suggesting instead that it "engaged in a complete review of the record to verify the absence of substantial evidence to support the jury's limited 'findings'." To the contrary, as scrutiny of the opinions by the District Court and the Court of Appeals for the Federal Circuit demonstrates, said appellate court did revert to *de novo* fact finding, in accordance with said court's irrepressible tendency which has been criticized by a Judge of said court in two recent cases, *Jones v. Hardy*, 727 F.2d 1524, at 1534 (Fed. Cir. 1984), and *Baginsky v. United States*, 697 F.2d 1070, at 1077 (Fed. Cir. 1983), *cert. denied*, ____ U.S. ____, 104 S. Ct. 423 (1983), *reh. denied*, ____U.S. ____, 104 S. Ct. 987 (1984). This criticism is borne out by recent statistics.[6]

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5. Roth's testimony was elicited by questions expressed in English, translated to German, and answered in German and translated to English, only the English versions being transcribed. The jury had the benefit of observing two weeks of trial testimony including this.

6. *Valmet Oy and TVW Papermachines, Inc. v. Beloit Corp.*, Docket No. 84-1664, is a Petition for Certiorari filed April 25, 1985, three weeks after the filing of the present Petition by Quaker City Gear Works, Inc. *et al.* Said copending *Valmet Oy* petition also seeks review and supervisory restraint of the tendency of the Federal Circuit Court of Appeals to usurp the fact finding functions properly relegated to the trial courts. The final page of the appendix to the *Valmet Oy* petition tabulates data showing that the ratio of the percentage of petitions from the Federal Circuit complaining of its *de novo* fact finding is some ten (10) times higher than the average of the petitions complaining of *de novo* fact finding by all the other U.S. Courts of Appeals.

For the foregoing reasons and those set forth in the Petition, certiorari should be granted.

Respectfully submitted,

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